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ELECTRICAL WORLD AND ENGINEER.

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THE IOWA ELECTRICAL ASSOCIATION.

We doubt whether any of the State electric light associations has a larger membership in proportion to the number of central station companies in the State than has the Iowa Electrical Association. We doubt also if there is any from which the members obtain more real practical benefit than from the Iowa Association. This body has pursued its work with very little ostentation for three years, and has proved already of great practical value to its members. The general lines of work most valuable have been the collection of comparative data of various kinds from various members. This is to be carried still further and will necessitate the keeping of more accurate records of all branches of central station performance in the future. The members of the association realize that a convention to be of any value must get down to something besides glittering generalities, and even though the facts and figures exchanged on the convention floor may be somewhat crude, they have a value; and are a stepping stone to greater refinements in practice. In no State has the advance in small central station administration been greater the past ten years than in Iowa; and Iowa is preeminently a State of small stations.

THE MUNICIPAL PLANT AGITATION.

Elsewhere in this issue will be found part of the address made by Mr. Bowers at Albany before the legislative committee against the proposed Monroe municipal electric lighting plant for New York City. It is a sober statement of incontestable facts, and explains in part, although by no means as fully as it could, why lighting, like many other things in New York, is more expensive than in some other much smaller places. Alongside this data, the phonographic yawp of the Merchants' Association about the "exactions of the lighting monopoly" becomes more ridiculous than ever. The prices charged by the city for replacing a granite pavement are a case in point; or those levied by it for asphalt work. The city has the audacity to take $8 for the first yard of granite and $4 for the second, from the lighting companies, when the work can be done reasonably for $2.50, while the asphalt "gouge" is in the same monstrous proportion. On top of that come further exactions for inspectors. And yet the Merchants' Association, under whose very eyes this goes on, prates about the cheapness with which the city can do its own work! It is impossible not to marvel at this manner of "merchant," and wonder how any of them ever escape the bankruptcy into which they would plunge the city by municipal plant extravagance.

Nor does this scope and plan stop at mere city supply. As we intimated at the outset of the agitation, general sale of current to everybody is contemplated, involving a plant of enormous capacity in direct competition with those already established. At a meeting in Cooper Union last week, ex-Senator John Ford said: "Why do the gas and electric companies combat the proposed change to municipal lighting, when they claim that but 4 per cent. of their business is composed of municipal lighting? It is because they know that municipal lighting will be a success, and that it will not be long before the municipal plant will not only be able to furnish light to the public institutions, but to private concerns and to householders. And they know that this will lead to the municipal ownership of all public utilities in this city." This is exactly what we contended was the ultimate aim; and if the public does not want to see such a plan of municipal operation of electric light plants, street railways, gas works, abattoirs, ferryboats, bakeries, icehouses, coalyards, milk

walks, and other enterprises, it had better call a halt on this propaganda now than later. Meantime we would advise the citizens of New York to be very distrustful of the alleged evidence laid before it by the agitating officials and the Merchants' Association, for the most casual examination of the data thus far brought forward by them in support of a municipal lighting plant shows it to be utterly unreliable and untrustworthy—as usual. Besides, we should like some of the municipal agitators to explain the little incident at Gravesend, L. I., where the municipal authorities of that New York suburb spent $120,000 of public money on an electric lighting plant, and so milked or mismanaged it that without ever giving service it had to be sold under the hammer for a bare $30,000. If that instance is not enough to turn any healthy stomach, we can quote a few more showing how fearful the economic results may be with unreflecting or dishonest movements of this kind.

ELECTROLYSIS OF WATER.

It has long been known that although a certain fairly definite e.m.f. was necessary to electrolyze water (somewhat lower than 2 volts) in order to produce any considerable quantity of the constituent gases, yet at pressures materially lower than the critical, a feeble electric current passes through the water, accompanied by polarization, but without any perceptible decomposition and generation of gas. Considerable interest attaches to this phenomenon, because it has been adduced in support of various theories of electrolysis otherwise mutually inconsistent. In our issue of last week a reprint of a paper on the subject by Prof. W. R. Whitney appeared. The essential fact is, however, as pointed out by Prof. Whitney, that the e.m.f. at which electrolysis of water takes place is such as conforms with thermodynamic theory after various corrections have been applied. It takes a certain amount of electric pressure to expend energy on the electrolyzing current sufficient to effect the molecular decomposition and expand the gases against gravitational forces. If a lower voltage could effect this decomposition, an explanation would have to be sought for the delivery of the energy of constituent gases or we would be confronted with an apparent failure in the law of conservation of energy.

The fact that a very feeble decomposition—a sort of microscopic decomposition of water—does occur below the critical voltage, is not a matter of great importance from the standpoint of energetics. The total quantity of energy to be accounted for in the phenomenon is very trivial, and in a physical organization so complex as an electrolytic bath of water including a pair of metallic electrodes, with the vast molecular activities in normal play, the little stock of energy necessary for maintaining the observed polarization current might be borrowed from any one of a variety of stocks, without creating any local evidences of theft that would attract attention, or be readily susceptible of measurement.

THE DEVELOPMENT OF THE ELECTRON IDEA.

A very noteworthy summary of the electron theory up to date, from the German standpoint, appears, by translation, in this number on page 648. Dr. Kaufmann traces the history of the development of the electron idea. The roots of the idea go back about twenty-five years. The growth of the stem has taken place within the last ten years, and now we have a flourishing plant, and a large literature on the subject. Broadly speaking, the latest theory accounts for inertia, suggests a cause for gravitation, explains the leading phenomena of the spectra of hot gases, and co-ordinates hypothetically a host of minor phenomena that seem at first sight to have no discernible mutual relationship.

The salient discovery is the recent one that the electric charge of a gramme of hydrogen matter is about ten millions of c.g.s. magnetic units, as connected with the phenomena of gaseous discharge, while in electrolysis, the apparent electric charge of a hydrogen gramme is only about ten thousand c.g.s. magnetic units. This unit is the quantity of electricity theoretically charged in a one microfarad condenser under an e.m.f. of ten millions of volts, so that a gramme of hydrogen, or equivalent gramme of other matter, contains an enormous amount of electricity stowed away unobtrusively in its molecules. The inductance of this electricity when set in motion is sufficiently great to account for the mechanical inertia of the mass to which it belongs. If the electrostatic attraction of unlike charges be assumed to be somewhat greater than the repulsion of like charges, then, according to Dr. Kaufmann, gravitation may be explained, only he does not state how he arrives at this result. A not inapt comparison of sizes is offered in the rough ratio—that an electron is to a bacillus or bacterion, as is a bacterion to the world at large.

Assuming that experimental tests continue to verify the electronic hypothesis, the discovery of the existence of these infinitesimally small quantities of matter, will remain a monument to the power of scientific research. And finally the process of conduction in metals is referred to ionic meandering just as it is in gases or in electrolytes, except that the ionic ranges and courses are very different in these different cases. The existing inference seems to be that without ions there is no conduction of electricity. We still possess, however, electrostatic induction through space as a process unpreempted by electrons.

OPERATION OF THE INDUCTION COIL.

A paper by Mr. Giovanni Giorgi, recently read before the Italian Electrotechnical Association, deals with the subject of induction coil building. The treatment is theoretical, but with a keen eye towards practical possibilities. There are a number of points of interest in this paper. One is a gem of a graphical method of representing correlated quantities by the aid of inclined cartesian axes, as distinguished from the ordinary perpendicular axes of ordinates and abscissas. The plan of attack is by the suppression and elimination of the secondary winding, whereby attention is concentrated upon the phenomena of the primary circuit. The type of coil which the deductions of the paper favor is a sort of shell transformer, with a narrow air-gap. In fact, the magnetic circuit of the apparatus, as sketched, has two gaps, one inside the coils, and the other outside. The iron core occupies about 80 per cent of the entire volume. Moreover, of the winding space, about three-quarters is given to the secondary coil, and one-quarter to the primary. The air-gap is recommended as being made adjustable. The form here recommended for a Ruhmkorff coil is, therefore, materially different from the classical form, and approaches much closer to a type of alternating-current transformer.

There is no doubt that the reinforcement of the iron core in an induction coil increases the stock of energy associated with a given current strength, and, therefore, potentially available for throwing into the spark-gap, or external circuit, on discharge. The only question is whether the sluggishness of electric action associated with so large a relative volume of iron core, even in a very finely laminated condition, may not more than absorb the advantage of the greater initial stock of energy, by unduly limiting the rate of magnetic collapse, and, therefore, the magnitude of induced secondary e.m.f. Experience in the past with induction coils for high potentials has hitherto established the empirical principle of limiting the quantity of iron core in the

spark-coil. The Tesla-Thomson coil, which produces, perhaps, the greatest magnitude of e.m.f. at present attainable, is noteworthy in this respect, because it has no iron core, and the introduction of any iron core within it seems to act prejudicially. Nevertheless, if a preponderance of iron in an induction coil can be made to effect an improvement, the electrotechnical arts will certainly welcome the old Ruhmkorff coil in its new suit of armor.

The paper contains reference to the "weber" as a unit of magnetic flux, in the practical system of ohms, volts and amperes. Thus interpreted, a change rate of flux of one weber-per-second induces one volt per linked-turn. This extension of magnetic units into the practical system is unfortunate, because it tends to make us measure our Ruhmkorff coils, and dynamos, in earth-quadrants as units of length, instead of in centimetres. Moreover, the already authorized magnetic unit of flux, the maxwell, in the C. G. S. system, is in fairly extended use in this country.

American Electrochemical Society.

The programme for the meeting this week in New York of the American Electrochemical Society is of surprising excellence, considering the youth of the body and the absence until its formation of any solidarity in this country among the workers in this branch of electrical and chemical application. Aside, however, from the reading and discussion of papers, the social features of the meetings of the society, which are wisely being given prominence, are of the greatest use. The membership of the society is principally composed of men who have rallied to the youthful industry from diverse walks of life, and the social occasions furnish the opportunity for becoming acquainted and aid in building up that *esprit du corps* so necessary to the well being of professional bodies. The present meeting promises to be more than ordinarily successful in this respect, each evening providing a programme of social entertainment. The arrangements for the banquet on Thursday have been particularly well laid, and with Dr. Nernst as guest of honor and with the presidents of the leading professional bodies of the United States as guests, the occasion will not only add prestige to the society but set an admirable precedent which the older professional bodies will probably not find it well to ignore.

The Vancouver Power Plant.

In these days of large and long transmissions it takes something more than ordinary in the way of engineering to cause the slightest general interest. A mere new transmission of 15 or 20 miles at 15,000 or 20,000 volts is deemed hardly worthy of a stick-full in the daily press. But there are some peculiarities in the case of the new Vancouver plant, described elsewhere in this issue, that are worth more than a passing notice. In the first place, the hydraulic arrangements are very unusual. With two lakes as the source of water, the projectors of this plant have tunnelled two and a half miles through a mountain more than 4,000 ft. high in order to use the lakes conjointly and to discharge the larger one through the smaller. A glance at the map shows the very unusual character of this hydraulic procedure better than words can describe it. We wish that our correspondent had given the facts and figures that led to the adoption of so extraordinary a plan. In itself it is tremendously expensive, and must have exceedingly good reasons as an excuse for existence. Ordinary sound practice would dictate merely the electrical union of the powers, particularly as about 8 per cent. of the total head is lost in their combination. Of course, the gradient of the Coquitlam River and the topography about the outlet of the lake may be such as to prevent utilizing its head effectively, but a two-and-a-half-mile rock tunnel will pay for a prodigious lot of piping, and it would be most instructive to learn the details that prompted so unusual and drastic a measure as a long rock tunnel. Incidentally, a main power house on the west side of the mountain involves a 2,800-ft. cable span over navigable water, a thing not to be recommended save under severe compulsion.

In the proposed station we find several features of exceptional interest. One in particular is the combination of needle valve and deflecting nozzle in the regulation of the water wheels. The impact wheel has done such sterling service in electrical power transmission plants that it seems almost ungrateful to criticize it, but really the control usually adopted—the deflecting nozzle—is quite the most wasteful device that it has yet entered the mind of man to conceive. Of course, regulation at the end of a long pipe line at nearly 400 ft. head is no joke, but neither is the loss of water, and it is quite certain that the scheme of regulation needs revision. We shall be greatly interested to see how the needle valve answers the purpose in this instance, although the main regulation seems to be still left to the deflecting nozzle. In the past, nozzle valves under such heads have been a constant source of trouble, but they do save water, which is very important when a little water means so much power. Nearly every plant on the Pacific slope uses the deflecting nozzle, with a similar waste of power. We wish that some one would make a careful study of the hydraulic efficiency of a plant so constituted, as might be done in some cases by means of a weir in the tailrace, with a view to determining the actual all-day hydraulic efficiency under these usual conditions. Unless we greatly err, the figure would be shocking to a degree which the average engineer hardly could bring himself to realize. Of course, sometimes it happens that the water would run to waste if not used, and if all the water be efficiently employed at the peak, the case is not so bad.

But on the other hand, at these high heads the storage of water is often very simple and cheap, and if the waste could be stored and used at the peak, the earning power of the plant might be very largely increased. On the coast a good water supply is nearly or quite as good as a gold mine, and economy in its use ought to be a step so obvious as to need no discussion. As to the general equipment of the big power house, one feature should be mentioned with particular commendation. This is the plan of installing the transformers, high-voltage switches, lightning arresters and the like in a separate building from the generators as a safety precaution. This is good practice, but let our Vancouver friends beware of making the Niagara mistake of running all the cables so that an accident to one will involve the others. Conduit and insulators are cheap, and the experience at Niagara ought to prevent any mistaken notion of order and symmetry from exposing the cables to a common danger. In fact, the lightning arresters need a separate fire-proof pen of their own more than any other class of apparatus, but oil transformers must be treated with respect on general principles and should be so placed that they cannot easily involve other apparatus in case of accident. The lines proposed have the excellent feature of being in duplicate, as all important lines should be. We are glad to note, too, that the apparatus is of the 60-cycle type, which has shown itself quite able to cope with all practical conditions yet encountered in power transmission. The low-cycle fad has never obtained a strong hold on the Pacific coast, where the really serious problems of long-distance transmission have been worked out. On the whole, this Vancouver plant is a capital type of the radical and daring engineering work that put the Coast in the front rank of progress, while the East was pottering about with fine-drawn theories and nursing conservative precedents.

Professor Walther Nernst.

Prof. Nernst, of Göttingen University, is in attendance at the meetings the present week in New York of the American Electrochemical Society, and on Thursday evening is to be a guest at the banquet of the society. As one of the originators and exponents of the modern theory of electrochemistry, which the new society is doing so much toward advancing in this country, and as the inventor of the electrolytic glow lamp, the distinguished professor needs but few words of introduction to our readers.

Prof. Walther Nernst was born in the neighborhood of Graudenz, in West Prussia, in 1864. He was a student of Prof. F. Kohlrausch, who has since become the president of the Reichsanstalt, and attended the Universities in Gratz, Wurtzburg, Zürich and Berlin. He was Privat Docent at Leipzig under Prof. W. Ostwald at the same time that Arrhenius was also at Leipzig. These two young men began life work in electrochemistry at this time and were much in each other's company, and their work is interlinked.

In 1895 Prof. Nernst, who had become full professor of electrochemistry at Göttingen, founded the first institute for this science. In the beginning of the year 1897, he began investigations of the theory of the light emission of the Welsbach mantle, and this led up in the same year to the discovery of the electrolytic light, the first patents for which were applied for at the end of the year 1897.

Prof. Nernst came to this country in the spring of 1898 for the first time and arranged for the development of his lamps, under the control of Mr. George Westinghouse. His example and personality have inspired many young investigators to dedicate their life to the work of discovery, among whom may be named Dr. Dolezalek, whose classic work on the accumulator is dedicated to Prof. Nernst.

PROF. WALTHER NERNST.

Aluminum Litigation.

Last week there was argued in New York before Judges Wallace, Lacombe and Coxe the case of the Cowles Electric Smelting & Aluminum Company vs. the Pittsburg Reduction Company, involving the Bradley electric furnace patent. This patent claims the electrochemical process consisting of the fusion by electric current of the charge in an electric furnace, the regulation of the current to the requirements of the fused bath, and the fusing of new matter as added to the bath. The case was on appeal from the United States Circuit Court at Buffalo. The present suit dates from 1879 and the issue was decided against the Cowles Company by Judge Hazel in December, 1900.

On April 4, Judge Wing, of the United States Circuit Court of the Eastern District of the Northern District of Ohio, handed down a decision which reopens the case of the Pittsburg Reduction Company vs. the Cowles Electric Smelting & Aluminum Company, the issue being the Hall patent. In a suit under this patent the Cowles Company in 1893 were declared to infringe the Hall process, and damages to the amount of several hundred thousand dollars have been assessed against the company under this decision. Judge Wing, in his decision, said that Judge Taft, when he refused a former petition for a rehearing, was much influenced by the fact, as it then appeared to him from the proofs used, that Hall, by his process, had lowered the cost of reduction of aluminum in a most marked degree. Important testimony, however, is proposed to be offered on the question as to whether or not internal heating sufficient to fuse is necessarily incident to the use of electric current in electrolysis; and there are other important questions raised by consideration of the proposed new testimony, the solution of which seems essential to a correct final decree. The court added that while it fully appreciates the weight and importance which should be given to a decision of so able a jurist as Judge Taft, it is of the opinion that, had he the case before him as now presented upon the present petition, unless restrained by the consideration of some imperative rule of practice in equity, he would give the defendant the opportunity of supplementing his proof in the manner prayed for.

As a condition to the granting of the petition, and of the defendant being allowed to reopen the cause and adduce new proof, the court required that all costs taxed in connection with the hearing before the master in ascertainment of damages and profits, should first be paid by the defendants. Upon the payment of such costs, an order may be drawn, providing for the reopening of the cause and the rehearing thereof, the defendant to be allowed to adduce such additional proof as he has set forth in his petition for a rehearing.

Chicago Meeting of the A. I. E. E. on High Tension Lines.

The Chicago branch of the American Institute of Electrical Engineers held a meeting Tuesday, April 7, to take up the subject of "High-tension Lines." The paper by Mr. Ralph D. Mershon on "Mechanical Specifications for a Proposed Standard Insulator Pin" was read by Mr. W. G. Carlton and an abstract of the communicated discussions also presented. By way of discussion, Mr. Carlton spoke of the advantages to purchasers if high-tension insulator pins could be obtained regularly in the market without special orders; something which cannot be done when there are no standards.

Mr. H. M. Lyman read the paper by Mr. F. O. Blackwell on the "Testing of Insulators" and also the discussion communicated thereon. Mr. Ernest Gonzenbach, in discussing the paper, said that while glass was condemned by some engineers, it was as warmly endorsed by others; and that as long as some of the highest voltage lines working commercially were equipped with glass it could certainly not be claimed that glass was not successful. Prof. P. B. Woodworth said that many glass insulators had been submitted to him for puncture test. He had found that the defective glass insulators were almost entirely those that had severe internal strains due to uneven cooling. Such insulators would fly all to pieces under a puncture test, and if their defective spots were pried at with a knife they would fly to pieces in the same way. They were evidently under interval mechanical tension. Such defective insulators could be sorted out by inspection, without test. Mr. H. H. Wait read the paper on "Transposition and Relative Location of Power and Telephone Wires," by Mr. Paul M. Lincoln. Mr. J. R. Cravath read the paper by Mr. C. C. Chesney on "Burning of Wooden Pins on High-Tension Transmission Lines," and also abstracted the discussions communicated on that paper. He further called attention to the fact that as long as the leakage current permitted by the insulator is sufficient in volume to burn a pin, the trouble can only be removed from the pin to some other point on the cross arm if iron pins are to be used, with wooden cross arms. The only final solution of the trouble was an insulator which would not leak or an iron pole line, and the latter is too expensive for common use in this country unless the new plan of the Guanajuato transmission were to be followed and the lines run on steel towers with spans of 400 or 500 ft. The burning of pins due to salt sea mist had been exceedingly troublesome on one plant that he knew of, but had been overcome by the use of boxes which prevent the drifting of fog and dust against the petticoat of the insulator.

At a meeting of the Executive Committee of the Chicago branch held before the meeting, action was taken on the resignation of Mr. R. H. Peirce as local secretary by deciding to recommend to the Chicago membership the nomination of Mr. Peter Junkersfeld, of the Chicago Edison Company, as local secretary.

This recommendation was endorsed by a vote of the members and referred to the council in New York for final action. Mr. Junkersfeld has been active in his work for the Institute and it is felt that the selection is an excellent one. The recent activity and development in Institute work in Chicago has rendered the post of local secretary a most important one.

Fig. 1.—Coquitlam Lake from Tunnel Portal, Looking Towards Outlet of Lake.

Vancouver Transmission Plant.

By Wyatt H. Allen.

In the early summer of 1902 work was commenced on the hydro-electric transmission plant of the Vancouver Power Company, Limited, near Vancouver, B. C., and while the completion of the undertaking is yet a matter of a year or more, there are many items of interest connected with the construction in progress and the plans for the completed equipment.

The installation of the plant is for the purpose of furnishing light and power for operating the street and interurban railways in Vancouver, New Westminster and Burnaby, and will ultimately have a capacity of 24,000 hp, for which the hydraulic end of the plant is being developed. The initial installation of machinery will have a capacity of 6,000 hp.

The sources of water supply for power are two very deep glacial lakes, known as Coquitlam and Trout, or Lake Beautiful. Their situation with respect to one another and to Vancouver is shown on the accompanying map. The first mentioned lake has an area of 2,300 acres, and is at an elevation of 32 ft. above the latter, which has an area of 460 acres. Both lakes are surrounded to their outlets by rugged mountains, rising abruptly from the shore lines, and between the two towers a granite range, 4,000 ft. above the water.

It is through this range that a tunnel, 13,000 ft., or nearly 2½ miles in length, is being driven to connect the two lakes for the purpose of using the stored waters of Coquitlam for the main supply and Trout Lake as a balancing reservoir.

Both lakes will be controlled by dams at their outlets, and from the dam at Trout Lake steel pipe lines will convey the water under an effective head of 390 ft to the power station, located just above high tide mark on the shore of the North Arm of Burrard Inlet, into which the water wheels will discharge.

The dam at the outlet of Coquitlam Lake will raise the water 12 ft. above low water level. It will be constructed of rock-filled timber crib, a type which has proven thoroughly successful in many mountain streams. The materials are provided by nature in ample quantity at the point where they will be used. The dam will be planked and constructed with an apron, extending far enough down stream to prevent any back cutting action by the water flowing over.

The tunnel is 9 ft. wide by 9 ft. in height, with rounded corners, and is being driven from both ends by compressed air drills. At the portals open cuts were carried into the solid rock, and at one end, where the depth of the open cut became inconvenient, a tunnel was driven for a short distance, temporarily timbered, and the ground above the roof of the tunnel stoped down through chutes in the roof directly into the car. Before the machine drills and air compressors arrived, hand drills were used, and the average progress was two feet per day in each heading, but since the advent of the drilling machinery this has been increased to 10 ft per day. A system of electric haulage has been installed to facilitate the rapid and economical removal of the muck. The plant at each end includes a 100-hp boiler, 60-kw, 500-volt generator and a four-drill, two-stage air compressor.

Ventilation is provided for by a 12-in. galvanized iron pipe, through which the air is exhausted by means of an air jet under 100 lbs. pressure, acting as an ejector. This is only put in operation for a few minutes after each blast to remove the smoke, the exhaust from the air drills furnishing all the fresh air necessary at other times.

A concrete dam 350 ft. long on the crest and 50 ft. high is now in course of construction across the outlet from Trout Lake, and arrangements have been made for bringing ten 54-in. pipe lines from the dam, but only three lines will be completed at the present time. Each steel pipe line will be 1,600 ft. in length, 48 in. in diameter at the upper end, 44 in. in the middle section, and 42 in. at the power station. Close to the power station site on the shore of the North Arm, a wharf has been erected, at which steamers and barges from Vancouver may discharge their freight on to the cars of an incline tramway, built from the wharf to the tunnel portal at Trout Lake.

By this means all material for the camp at the tunnel portal and for the dam and pipe lines is delivered rapidly and with the least possible handling.

FIG. 2.—POWER HOUSE SITE.

To deliver material to the tunnel camp at the Coquitlam portal is quite a different undertaking, since it can only be reached by wagon road from a station on the Canadian Pacific Railway, ten miles distant. For the greater part of the distance the road penetrates the dense forests, and in winter can be kept in a passable condition only by constant attention.

The power station will be constructed of granite masonry and much of the material excavated to obtain a building flat will be used in the walls.

The water wheel equipment will consist of three sets of impulse wheels, made by the Pelton Water Wheel Company, each set capable of developing a maximum of 3,000 hp at 200 r.p.m., under the effective head of 390 ft., and one set consisting of 200-hp wheels for driving

the exciters at 580 r.p.m. Each of the main units will consist of two overhung wheels, one mounted on each end of the shaft of a 1,500-kw Westinghouse engine type rotating-field generator. The wheel centers are of the steel disc type, and fitted with cast-steel buckets, secured to the wheel rim by turned steel bolts driven in

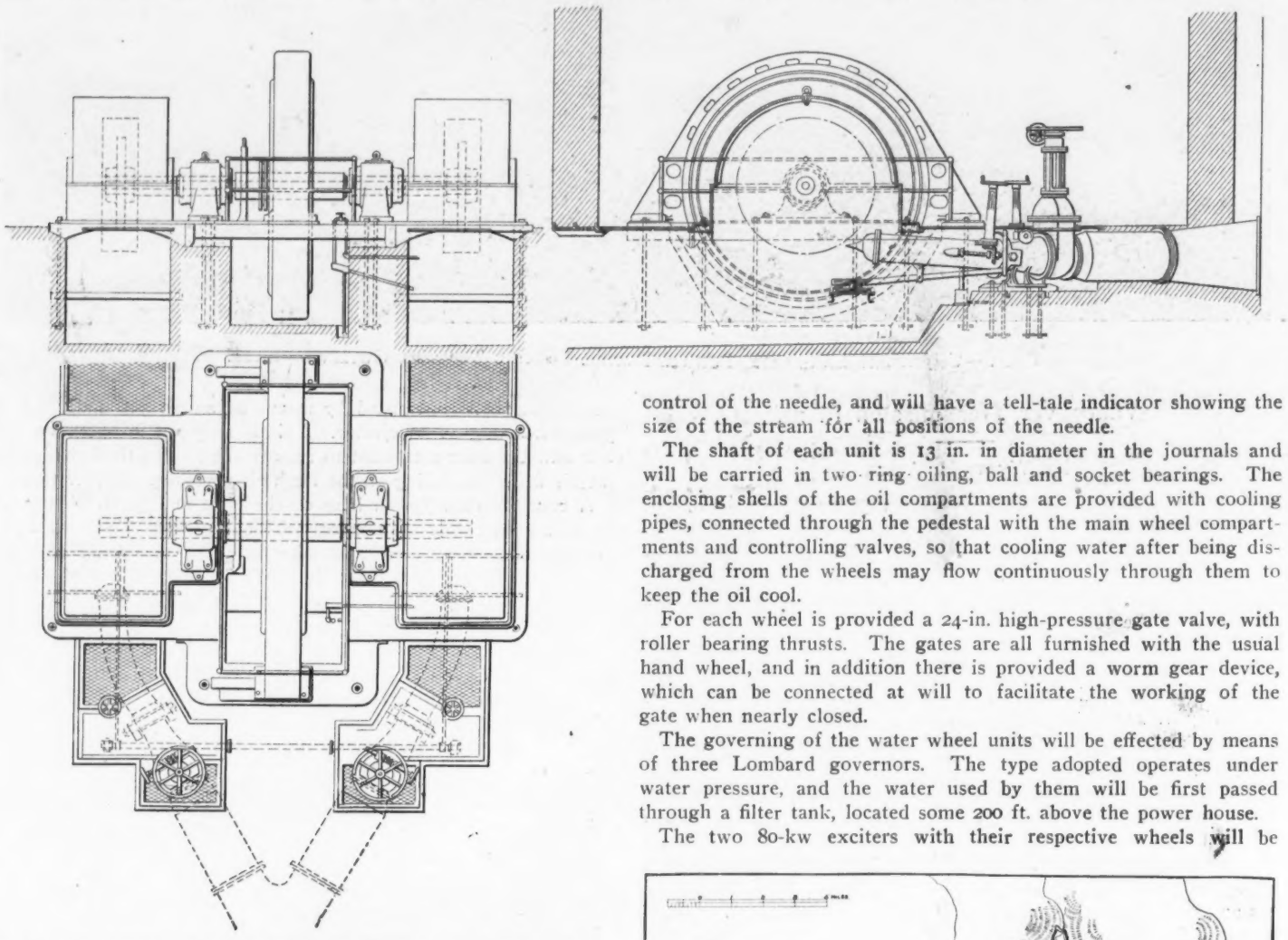


FIG. 3.—ELEVATIONS AND PLAN OF WATER WHEELS AND GENERATORS.

reamed holes. The hubs of the wheel centers are bored out for a press fit on a shaft 12 in. in diameter, and will be pressed on in place at the power station. Each wheel will be enclosed in a cast-iron housing, and provided with centrifugal discs and pockets, and suitable drain pipes for preventing leakage of water along the shaft.

Probably the most interesting feature of the equipment is the single combination, deflecting and needle regulating nozzle provided

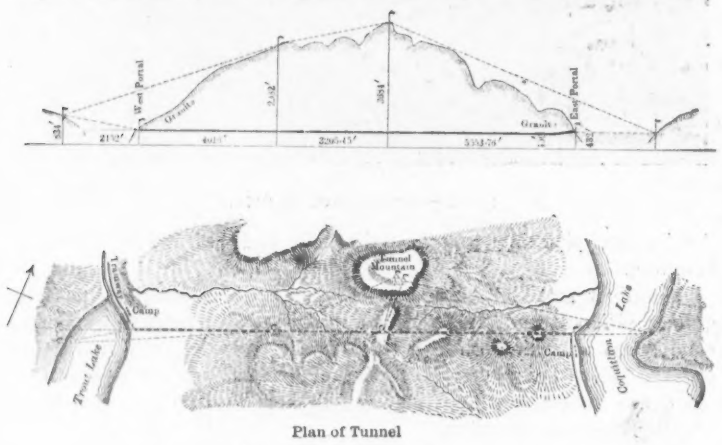


FIG. 4.—CROSS-SECTION AND PLAN OF TUNNEL.

for each water wheel, and fitted with a high-pressure ball joint, which is leather-packed, and rocks on forged steel trunnion bolts. The joint permits of effecting regulation by deflecting the nozzle by governor or hand, independent of the control of the needle, thus permitting of load and speed variations, independent of any change of velocity in the pipe lines. The deflecting portion of the nozzle is counterbalanced by hydraulic pressure, so that quick operation can be secured from the governor on account of the absence of inertia of heavy counterbalanced weights. The taper pipe of the nozzle is provided with the necessary geared connections for hand control of the needle, and will have a tell-tale indicator showing the size of the stream for all positions of the needle.

The shaft of each unit is 13 in. in diameter in the journals and will be carried in two ring oiling, ball and socket bearings. The enclosing shells of the oil compartments are provided with cooling pipes, connected through the pedestal with the main wheel compartments and controlling valves, so that cooling water after being discharged from the wheels may flow continuously through them to keep the oil cool.

For each wheel is provided a 24-in. high-pressure gate valve, with roller bearing thrusts. The gates are all furnished with the usual hand wheel, and in addition there is provided a worm gear device, which can be connected at will to facilitate the working of the gate when nearly closed.

The governing of the water wheel units will be effected by means of three Lombard governors. The type adopted operates under water pressure, and the water used by them will be first passed through a filter tank, located some 200 ft. above the power house.

The two 80-kw exciters with their respective wheels will be

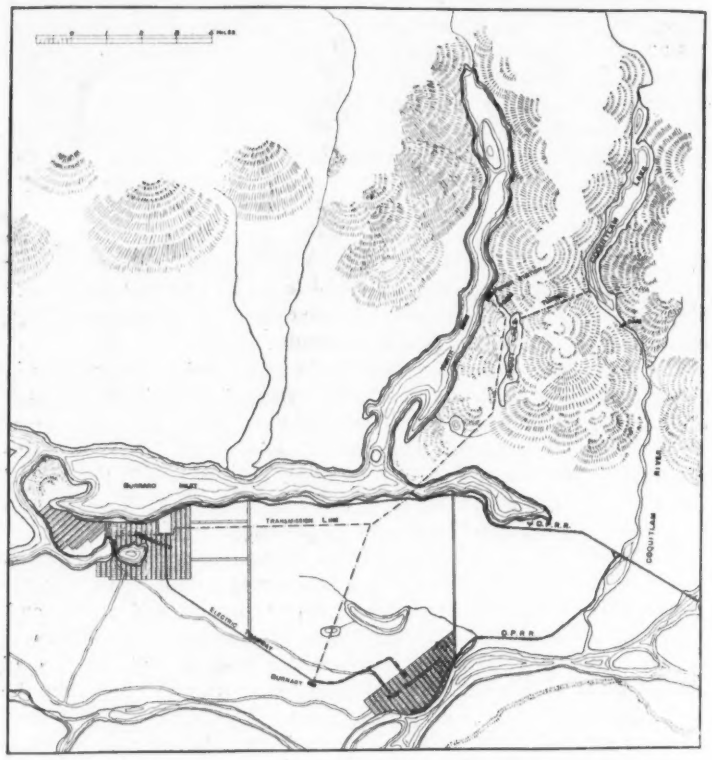


FIG. 5.—MAP OF PROPOSED DEVELOPMENT.

mounted on a common bed plate, with a 120-hp induction motor between the two exciters. Each exciter will be provided with a pair of jaw clutch couplings and shifter rigging, so that either water wheel will drive its exciter and the induction motor at the same time. The motor leads are connected to the main bus-bars, and the motor

FIG. 6.—TUNNEL CAMP, PLANT AND BUILDINGS; TROUT LAKE PORTAL JUST ABOVE TUNNEL PORTAL.

FIG. 7.—TEMPORARY CRIB DAM.

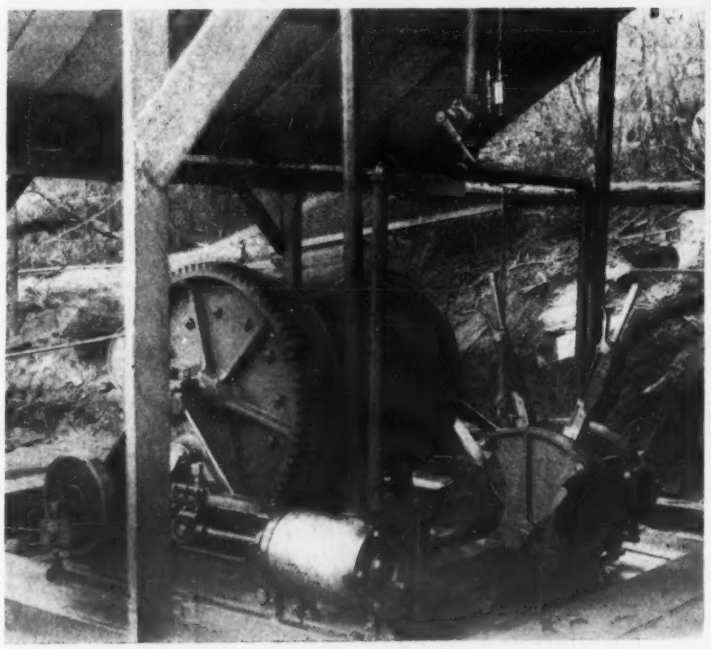


FIG. 8.—HOISTING ENGINE AT TOP OF INCLINE.

FIG. 9.—VIEW OF INCLINED TRAMWAY FROM WHARF.

FIG. 10.—WAGON ROAD TO COQUITLAM PORTAL.

VANCOUVER TRANSMISSION PLANT.

is normally run at synchronous speed, neither giving nor taking electric power. Should the exciter water wheel nozzle become clogged and the speed fall, the motor immediately takes power from the bus-bars and drives the exciter until the nozzle is cleared by the attendant, or the other exciter unit started up. The deflecting nozzles of the exciters are arranged for hand regulation from the exterior of the wheel case through worm gearing.

The contract for the entire electrical equipment has been awarded to the Westinghouse Electric & Manufacturing Company, and includes the apparatus for the generating station and the sub-stations at Vancouver and Burnaby.

The three 1,500-kw, 60-cycle, 2,200-volt alternators for the power station are of the rotating field type, and arranged for a movement of the external frame in a direction parallel to the shaft to allow access to the windings.

For the control of the apparatus at the power station, the switchboard will contain nine panels, one for the induction motor and one for each exciter, three panels for control of the main units, and three for the control of the three sets of 550-kw air-cooled transformers, with their motor blower sets, consisting of 20-hp motors and 110-in. Sturtevant fans.

The step-up transformers, static interrupters, high-potential switches and lightning arresters will be installed in a separate building located on the hill above and just back of the power house. As the static interrupters contain oil, they will be separated from the main room and each other by brick partitions.

The machinery for the sub-stations includes the usual transformers, rotary converters, switchboards, etc., for the reception and distribution of transmitted power.

The route of the transmission lines to Vancouver is 16 miles in length, and involves the crossing of a navigable arm of Burrard Inlet, with a span of 2,800 ft. On one side two steel towers 140 ft. in height will be erected to support twelve 9-16-in. galvanized plow steel cables with wire centers, but on the opposite side there is high ground and the cables will be supported on poles.

Two independent transmission lines, each consisting of two 3-wire circuits of No. 2 copper, will be constructed on the same right of way, to a point near Barnet. From here one line will be continued to Vancouver and the other to Burnaby.

A transmission line already exists between Burnaby and Vancouver, which will be reconstructed to carry 20,000 volts, the pressure to be used on the new lines, and a new line will be built from Burnaby to New Westminster, thus providing what is in effect a double transmission line over the entire distance between the power station and each of the sub-stations.

Mr. Wynn Meredith, of the Engineering Offices, of San Francisco, is directing the entire work, assisted by Messrs. Hermon and Burwell, civil engineers, of Vancouver.

St. Louis Exposition Congresses.

The administrative board of educators and scientists appointed to organize and conduct the international congresses to be held in connection with the World's Fair in St. Louis in 1904, met last week at the Eastern offices of the exhibition, at 23 West Thirty-fourth Street, New York City. There were present President Butler, of Columbia University; President Harper, University of Chicago; President Jesse, University of Missouri; Dr. Herbert Putnam, Librarian of Congress, and Frederick W. Holls, member of The Hague Tribunal. The board met to consider the report of the Committee on the Congress of Arts and Science, which had been in session the two preceding days. The members of the committee met with the board. They are: Prof. Simon Newcomb, Washington; Prof. Hugo Münsterberg, Harvard University, and Prof. Albion W. Small, University of Chicago. Howard J. Rogers, Director of Congresses, was also present.

There is to be one "Congress of Arts and Science," but there will be 128 sections in the congress, and for ordinary purposes there will be that many congresses, although they are grouped together, as showing the unity of knowledge.

The board adjourned to meet in St. Louis on April 29, when the final announcement of the schedules, with the names of those who will take part in the exercises at the meetings of the various sections, will be made.

The Development of the Electron Idea.*

By W. KAUFMANN.

Translated by A. P. Wills.

IT is not an uncommon occurrence in the history of science that ideas, which have long been held as antiquated and discarded, suddenly make their appearance again in a more or less modified form. The revolution of our ideas in the course of the last decade concerning the electrical phenomena about which I have the honor to report to-day, offers an extremely interesting example of this.

The modern theory of electrical phenomena and the closely allied theory of optical phenomena, which may be affiliated under the name electrontheory, indicate to a certain degree a return to ideas enunciated by Wilhelm Weber and by Zöllner in the years between 1860 and 1870, but modified through the results of the researches of Maxwell and Hertz. W. Weber conceived electrical phenomena as the action of electrical particles, so-called electrical atoms, whose mutual influence depended not only on their position but also upon their relative velocities and accelerations. Now, although Weber, by means of his assumption, succeeded in describing perfectly the then known electro-dynamical processes, and even in giving a qualitatively useful explanation of the proportionality between electrical conduction and heat conduction in metals as well as for Ampere's molecular currents in magnets, still, his theory was far from becoming the common property of the physicists of the time. The reason for this may well be sought in the fact that most of the laws of electro-dynamics expressed in the form of differential equations show up much more conveniently and simply than the Weber formulæ; furthermore, Weber made no attempt to calculate the magnitude of the electrical atoms conceived by him or to test the results of calculation through their application to other molecular processes. But finally, it came about, through the work of Faraday and Maxwell, that every one was convinced that in electrical and magnetic process a propagation requiring time is involved instead of immediate action at a distance, a claim, moreover, which Gauss established in a letter to Weber in 1845, but which was not satisfied by Weber's law. The articles of Maxwell, which had already appeared in 1861-62, and which he collected in his celebrated "Treatise on Electricity and Magnetism," in 1873, and the striking experimental confirmation of Maxwell's results by Hertz from 1887 on, appear capable of taking the last vestige of right to existence from Weber's notions.

In fact, the formulæ of Maxwell represented the fundamental electrical phenomena just as well as those founded on the notion of action at a distance while the atomic ideas are not at all involved in these formulæ; and the recently discovered Hertzian waves could only be represented on Maxwell's theory.

It appears as though this striking result had blinded investigators as to the insufficiency of Maxwell's theory as regards the more delicate optical phenomena. According to Maxwell light vibrations should not be regarded as mechanical vibrations of the ether, but as electrical vibrations, and the two constants by means of which Maxwell defined the electrical and magnetic behavior of bodies (the dielectric constant and the magnetization constant) must also be criteria of their properties of light refraction. Now, although the relation demanded by Maxwell (namely, that the index of refraction be equal to the square root of the dielectric constant) was tolerably well satisfied by many bodies, still, on the other, hand, many bodies, water, for example, showed such tremendous deviations that the theory in its original form was proved insufficient. The question of the dependance of the refractive index upon the color came in here, for which the original theory gave no explanation.

Now, Helmholtz, after a previous yet unsatisfactory attempt of Sellmeier, in 1874, framed a mechanical theory of color dispersion, whose basis consisted in this: *That the mass molecules have certain vibrations of their own.*

In the year 1880, at a time, when physicists in Germany still scarcely believed in Maxwell's electromagnetic theory of light, H. A. Lorentz showed that the principles of an electromagnetic theory of dispersion could be obtained quite analogously to the earlier mechanical theories if only every molecule be considered as the

* The original of this paper was presented in the form of an address before the Gesellschaft Deutscher Naturforscher und Arzte at Hamburg, Sept. 25, 1901. This translation has been authorized by Dr. Kaufmann.

origin of electrical vibrations of a fixed period. He says: "There may be in each particle of a body numerous points charged with electricity of which, however, only one with the charge e and the mass μ may be movable." With the aid of this fundamental assumption of elementary charged particles capable of vibration, Lorentz derived the equations of dispersion. .

Now the next question is: How may we assume the presence of electrical particles in a transparent body? The answer leads to a new field of phenomena which only with difficulty fits into the theory of Maxwell. I refer to the processes of electrolysis. According to Faraday's law, when an electric current flows through an electrolyte, for every unit of current which flows a chemically equivalent quantity of matter is separated out on the electrodes. The process can be regarded as though each chemical valence of each of the migrating ions in the electrolyte were connected with an entirely determinate invariable amount of positive or negative electricity.

In an address at a memorial to Michael Faraday in 1881, H. V. Helmholtz asserted that we must admit, from Faraday's law, the existence of electrical atoms. Since the charged chemical atoms designated by Faraday as ions (i. e., migrating) are separated on the electrodes as neutral substances, there must take place there a surrender of the charges, or a partial exchange with charges of the opposite sign. During this process, which cannot take place instantaneously, these charges must be capable of a separate existence, at least for a short time; what is more natural than to regard this continuously equal unit of charge of a valence as an elementary quantity of electricity, as an electrical atom? And when a neutral molecule, NaCl (sodium chloride) for instance, dissolved in water breaks up into positively charged Na and negatively charged Cl, it is most probable that the sodium and the chlorine atom each had its charge before, and that these charges remained undetected because the positive charge and negative charge were equally large. Now, if we imagine a ray of light to traverse a NaCl crystal, then must the charges and the atoms connected with them come into vibration and influence the light motion. *The electrolytic valence charges are, therefore, those which we have to regard in transparent bodies as the vibrating electrical particles* (whose forces of attraction, as Helmholtz pointed out, make up by far the greatest part of chemically related forces).

Although, as before mentioned, the ground lot for the structure of the electromagnetic theory of light had already been indicated by H. A. Lorentz and even, suggestively, much earlier by W. Weber, it still needed a full decade before physicists, stimulated meanwhile by the discoveries made by H. Hertz, began to get the building stones together and to build. In the years from 1890 to 1893 a series of researches appeared by F. Richarz, H. Ebert, G. Johnson Stoney, which in large measure had to do with the mechanism of light emission from glowing vapors and in which from the standpoint of the kinetic theory of gases it was attempted to determine the magnitude of the elemental electrical quantity supposed by Helmholtz, and for which Stoney proposed the generally used name, electron.

The result of these calculations is of importance in so far as it shows us that the numbers found contain no contradiction with other knowledge.

For example: B. H. Ebert showed that the amplitude of vibration of an electron in glowing sodium vapor needs to be only a small fraction of the diameter of a molecule in order to excite a radiation of the absolute intensity determined by Wiedermann.

The method of calculating the quantity of electricity contained in the electron is very simple. The quantity of electricity necessary for the electrolytic deposition of 1 c.cm of any monotomic gas is divided by the number of gas molecules contained in 1 c.cm. On account of the uncertainty of this last number one can only say that *an electron contains about 10^{-10} electrostatic units.*

The value of this result were very problematical had not a whole series of other entirely different methods (which will be entered into to some extent later) led to quite similar values.

While it was thus being demonstrated that the observed phenomena were compatible in order of magnitude with the assumption of vibrating electron charges, two independent researches appeared through which the electromagnetic theory of light was made a complete structure. Concerning these researches the first by v. Helmholtz was concerned only with the special question of color dispersion in absorbing media; the other by H. A. Lorentz goes decidedly further. Here it is shown how through the assumption of vibrations of charged particles in transparent bodies all obstacles disappear which oppose a satisfactory explanation of the propagation of light in moving bodies as, for example, the aberration of starlight. Lorentz's theory allows Maxwell's equations for free ether to remain unchanged. A material body influences optical, as electrical processes, only through the moving charges present within it, while in the ether filling the interspaces everything remains unchanged. There is, therefore, no longer, according to Lorentz, a "dielectric constant" as a fundamental idea, as with Maxwell. It becomes a derived idea; and one also sees immediately that for rapid vibrations where the inertia of the vibrating charges comes into consideration it has no longer any meaning. The same holds mutatis mutandis for the constant of magnetization.

By virtue alone of the ease with which the theory of Lorentz explains the phenomena of dispersion and aberration, a direct proof of its correctness is scarcely necessary. At the same time this ought not to be deferred.

In 1896, P. Zeeman, a student of Lorentz, discovered a phenomenon, the existence of which Faraday had already (1862) sought in vain.

If one brings a glowing vapor, a sodium flame, for instance, into a strong magnetic field, the spectrum lines of the vapor show peculiar changes consisting essentially in a doubling or trebling of the lines according to the direction from which the phenomenon is viewed; changes which, according to the theory of Lorentz, are completely predicted.

Further, the Zeeman phenomenon permitted the determination of the material masses connected with the vibrating charges with a result which is somewhat striking: *the vibrating electron is always negatively charged, while the positive electron is at rest; the ratio of charge to mass amounts to 17,000,000 El. M. U. per gram; now,* since a gram of hydrogen, that is, a gram valence, contains only 9,650 El. M. U., the mass connected with the vibrating electron amounts to only the two-thousandth part of an atom of hydrogen. The assumption, almost tacitly introduced originally, that the whole ion that is chemical atom plus valence charge vibrates, must therefore be done away with; we must suppose that the charge in a light omitting molecule has an independent motion, just as in electrolytic deposition at the electrodes of an electrolytic cell; and that the mass *involved in the Zeeman phenomenon is that of the electron itself.*

Accordingly, a point of view is attained which nearly coincides with the old assumption of Weber, but, of course, with the important difference that in place of immediate action at a distance there has appeared propagative action through the ether; and that we now possess a fully determinate numerical representation of the magnitude of the electrical atoms. Still another difference, as regards Weber, must be brought out here. Weber assumed at random, in his theoretical considerations, the positive particles as the freely movable ones. But now, on account of the Zeeman effect, we have always to assign this place to the negative particles. Moreover, it has happened that in other phenomena in which electrons come into consideration *the negative ion always enters as the freely movable one;* of some of these phenomena we shall learn hereafter. As to the question whence this remarkable dissymmetry originates, we must await the decision of the future as to whether it will sometime be possible to recognize the free positive electron, or if, perhaps, in place of the dualistic a unitary conception of electricity has to be adopted.

There soon followed upon the development, just sketched in, of the electron idea in the domain of the theory of light a wholly similar one in the domain of purely electrical phenomena.

Physicists for a long time had tried to consider electric discharges in gases as a process related to that of electrolysis. It was W. Giese who first lent important support to this hypothesis through investigations on conduction in gas flames, and who also sought to explain conduction in metals through the migration of ions.

But before all, it was to the so-called cathode rays that physicists now devoted the greatest attention partly on account of the resulting discovery of Röntgen rays toward the end of 1895. Plücker and Hittorf were the first to study accurately the peculiar fluorescence of the glass walls in very highly exhausted discharge tubes. In the course of further investigations, in which E. Goldstein accomplished so much, it appeared that a peculiar kind of radiation must be considered; this proceeds from the negative electrode, that is, the cathode of the tube, and on this account Goldstein proposed the name cathode rays. Crookes attempted to explain the behavior

of these rays in a magnetic field, their heat actions and their supposed mechanical effects on the assumption that the rays consist of gas molecules which, charged negatively at the cathode, were propelled into the tube after the manner of the "electric dancing spheres." In fact, most of the observed phenomena may be tolerably well interpreted on this hypothesis.

More accurate investigations, namely, numerical tests, very soon showed, however, the insufficiency of Crookes's hypothesis, at least in its original form. Thereupon, unfortunately, physicists in Germany "poured out the child with the bath"; they discarded the whole hypothesis because the entirely special conception that it had to do with molecules charged through contact proved false. But they were not in a position to furnish anything better in its place; the more facts were heaped up the more problematical became the cathode rays, and finally it went so far that it was considered unworthy of a reputable physicist to occupy himself with these phenomena so inaccessible of quantitative and theoretical treatment. Suddenly there came of all enigmas the greatest: *the discovery of the X-rays by Röntgen,* and with it a new spur to take in hand the solution of many questions. The pains taken ought soon to be crowned with success.

The investigations of E. Wiechert, W. Kaufmann and E. Aschinass, J. J. Thomson, W. Wien, Ph. Lenard, Th. des Coudres all indicated that only a modification of Crookes's hypothesis was required to furnish a non-contradictory explanation of almost all the phenomena. One only needs to consider the cathode rays as charged mass particles, *which are much smaller than ordinary atoms.* A whole series of measurable properties of cathode rays makes it possible to determine how great the charge is on these particles per gramme mass. The result was somewhat different with different observers; it varied between 7 and 19 El. M. U. per gram; but in any case these numbers lie so near that found from the Zeeman effect that one can unquestionably agree with the hypothesis, first enunciated by E. Wiechert, that we have to do in both cases with the same particles, namely, the electrons. We have, therefore, bodily before us, so to speak, the electrons in the cathode rays, which in optical phenomena lead a somewhat hidden existence.

A whole series of results of experiment was now capable of explanation in a very simple manner. Such an electron flying with tremendous velocity (according to the direct measurements of Wiechert, 1/5 to 1/3 that of light, depending on the applied force) must, when it rebounds from a fixed body, send out an electrical wave of explosive nature into space, exactly as a striking projectile sends out a sound wave; we have valid grounds for the assumption that Röntgen rays are such waves. Furthermore, if the electrons fly off from the surface of the cathode, then they must have moved from within the cathode to the surface; *that is, electrical conduction in metals consists also in a migration of electrons.* While in liquid electrolytes the electron always appears connected with a material atom as an "ion," in metals we have to do with free wandering electrons. This electron theory of metals, of which we have to consider W. Weber the author, has recently been so far worked out mathematically by E. Riecke and P. Drude that it permits a trial at the hands of experiment; the number found for the ratio between electrical and heat conduction in metals agrees to a few per cent. with those observed; moreover, the optical behavior of metals seems, so far as the observations go, to stand in good agreement with this theory, and furthermore, it has been shown by Ph. Lenard that through radiation of ultra-violet light upon a metal surface the electrons can be brought into such strong vibration that they fly off from the surface with great velocity and then show a wholly similar behavior to the ordinary cathode rays produced by discharges.

Let us consider finally the conduction in any gas that is made conducting through the passage of Röntgen rays or ultra-violet light or through heating; here again it appears that an explanation, free from objections, of the numerous results which have been obtained by J. J. Thomson and his students, is only possible on the assumption of migrating particles in the gas; from certain differences in the behavior of the positive and negative particles in these processes, it appears that the negative ions are principally the free ions; most of these, however, after a short migration, are caught up by gas molecules, and loaded by these lose a large part of their original mobility. The positive particles after the splitting off of a negative electron from the molecule, remain in a state of rest. The point of view sketched in above completely ignores the objection which formerly physicists sometimes believed to refute the ion theory for conducting gases. How can, they asked, a monotomic gas, mercury vapor for example, dissociate into ions? *Into electrolytic ions certainly not, but into a positively charged ion and a negative electron. Both together form the neutral monotomic molecule.* J. J. Thomson has succeeded, through observations on conducting gases, in measuring directly the absolute magnitude of a single ion, and there resulted a very good agreement with the value for the elemental quantity mentioned above. It is to be added further that a nearly equal value has been found by M. Planck in a third, completely independent way, from the laws of radiation of the so-called "black body."

In all conditions of aggregation, in electrical and optical processes the electrons play a very important rôle; they are, up to now, the smallest known constituents of our visible world; furthermore, in the absence of external electrical or optical evidences that is the direct proof of their actual existence, their actual appearance would, as it were, form the keystone in the logical structure whose rise I have endeavored to exhibit to you; and we have no need to seek far for this stone.

Shortly after the discovery of the Röntgen X-rays, Becquerel found that compounds of uranium send out continually, without outside influence, a kind of radiation which has a great similarity to Röntgen rays; and later G. C. Schmidt showed that thorium compounds send out similar rays. Further investigations, namely, on the part of M. and Mme. Curie, established the fact that these rays do not proceed from the uranium itself, but from certain impurities which may be separated out by an exceedingly tedious fractional process and finally so concentrated that they radiate about 50,000 times more strongly than the uranium. It appears that in the final product, which for the most part consists of a salt of barium, a new element is contained to which the name radium has been given, though to be sure it is by no means proven that it is just this new element which is the origin of the radiation. Now, concerning these Becquerel rays, which, in the beginning, were held to be closely related to Röntgen rays, Giesel and shortly afterward Becquerel, likewise St. Meyer and Schweidler, found them to be capable of deviation with a magnet, and hence preferably to be classed with cathode rays. After Dorn and Becquerel had established the electric deviability of these rays and its amount had been measured, although only roughly, the velocity and the charge per unit mass could be calculated; and the result was, in order of magnitude, in agreement with the numbers obtained for cathode rays. From the latest and more accurate experiments of these physicists a complete agreement seems to follow.

Consequently, we have in the radium salts a class of bodies which are in the position to throw off electrons without any outside influence. We stand before a perfect riddle as regards the source of energy, likewise of the whole mechanism of this phenomenon, especially as it appears that here velocities have to be treated which are nearly equal that of light; velocities which we can reach by means of electrical forces, that is, in actual cathode rays, only after overcoming enormous difficulties. Thick lead plates are radiated through at this velocity without a noticeable loss of energy. But just this behavior of the electrons at such tremendous velocities seems suited to furnish explanations in connection with the deepest questions concerning the constitution of the electrons, likewise of the atoms. Above all it is possible through direct measurement to decide whether the mass of the electron is perhaps only "apparent," due to electromagnetic actions. The experiments carried out up to the present time show that at any rate a considerable fraction of apparent mass is present.

And here we come upon a question which deeply concerns the structure of matter in general:

When an electrical atom merely by virtue of its electrodynamical properties behaves so exactly like a mass particle, is it not then possible to consider all masses in general as only apparent? May we not now, instead of all the fruitless experiments to explain mechanically electrical phenomena, attempt to refer back mechanics to electrical processes? Here we come back again to ideas which were cultivated by Zöllner thirty years ago, and which have recently been taken up and improved upon by H. A. Lorentz, J. J. Thomson and W. Wien. *If all material atoms consist of a conglomerate of electrons then their inertia follows of itself.*

For the explanation of gravitation, the attraction between unlike charges must be assumed somewhat greater than the repulsion between like charges. An *experimentum crucis would be the proof of*

the propagation of gravitation with time; of its dependency not only upon the position, but also upon the velocity of the gravitating bodies.

The electrons would then be the "fundamental atoms" sought after by so many, through the various groupings of which the chemical elements are formed; the old dream of the alchemists would be placed strikingly near actuality. It could be assumed, perhaps, ***that among the innumerable possible groupings of electrons only a relatively limited number are sufficiently stable to occur in large quantities; these stable groupings would then be the chemical elements known to us.*** Through a mathematical treatment of these questions it will, perhaps, sometime be possible to represent the relative abundance of the elements as a function of their atomic weights and to solve, perhaps, many other riddles of the periodic system of the elements.

If from the earth we throw a glance about the universe we see many phenomena to which physicists, not without prospect of results, have sought to apply the electron theory; among these belong the sun's corona, the tails of comets and the northern lights.

While much of what has just been said may appear somewhat too hypothetical, yet so much clearly follows: that the electrons, these petty particles whose magnitude is to that of a bacillus as that of a bacillus to the whole earth, and whose properties we are still able to measure with the greatest precision, form one of the most important constituents of our whole world structure.

Effect of High Potential Discharge on Mica Insulation.

BY JOHN HÄRDÉN.

IN a paper in the *Transactions* of the American Institute of Electrical Engineers, 1892, p. 1162, Mr. W. S. Andrews shows that mica loses its insulating properties if it is dipped in oil, or if oil is put on it. He states that a thin sheet of mica which would stand in air a potential of 10,000 volts alternating, dipped in oil it breaks down at 4,000 or 5,000 volts. One might suppose that a change in the surface of the mica takes place, but that this is not the case, the following experiment shows. Mr. Andrews used an apparatus represented in Fig. 1.

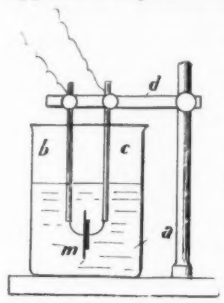


FIG. 1.—DIAGRAM OF APPARATUS.

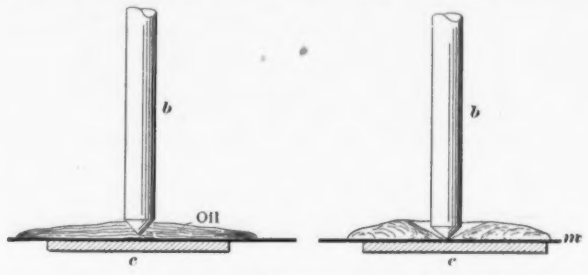
In the vessel, *A*, containing oil, two rods, *B* and *C*, are dipped. The rods are insulated by the piece of rubber, *D*. The brass rod, *B*, is sharply pointed, while the rod, *C*, ends in a brass disc. Between the two, sheets of mica, *M*, are placed between point and disc, supported by a steady pressure of the brass rods. Rods *B* and *C* are connected with the terminals of a step-up transformer. The mica had in one case a thickness of .002 in. and withstood a pressure of 8,000 volts with no oil in the vessel. When a drop of oil was put at the point, *B*, or oil was poured in the vessel, the insulation broke down at about 5,000 volts.

I tried this experiment in order to find the explanation of the phenomena, and obtained the following result. No change in the material of the dielectric took place, except that if a spark is passed through the oil, the insulating property of the oil will drop, as it will be carbonized through the heating effect of the spark, and small particles of carbonized oil act as a bridge for the electric discharge. While no change was observed on the surface of the mica, there was a change in the current density per unit of surface of the mica, and this is characteristic of all dielectrics if dipped in oil. This phenomenon can be explained in the following way:

Referring to Figs. 2 and 3, if a sheet of mica is placed between the point and the disc, and an electric charging apparatus is so connected that a high-potential difference is maintained between the point and the disc, if the point has the sign plus, a radial discharge takes place from the point to the edge of the mica if no hindrance is opposed. This energy of the discharge is transformed into heat so that the mica becomes hot. Since the discharge coming from the point has always the same sign, the particles repel each other, and the discharge is spread over the whole surface. This distribution of the electric charge on the surface of the dielectric is combined with a fall of potential over unit of surface; or in other words, the electric pressure per unit surface, *dc df* is less.

If a drop of oil is now placed on the plate, the oil will be driven out in a cup shape all around the point, as indicated in Fig. 3. The walls of the cup made by the oil concentrate the discharge all around the point, so that the electric pressure per surface unit in the neighborhood of the point will be higher. Suppose that the mica thus breaks down at 6,000 volts; if no oil is placed on the surface, the discharge will be distributed over the whole plate, so that a potential difference of 10,000 volts on the terminals of the transformer will be necessary to make the pressure per unit surface equal to that when 6,000 volts are used with oil. If, however, oil is on the plate, or the plate is dipped in oil, so that no distribution of the discharge can take place, the potential fall will be less. The dielectric will then break down at 6,000 volts, this voltage being present both at the terminals and at the points.

In order to prove this, I took a sheet of mica 1-32 in. thick and



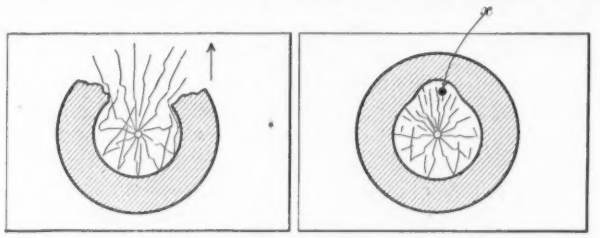
FIGS. 2 AND 3.—EFFECTS OF HIGH-POTENTIAL DISCHARGES ON MICA.

placed it between the terminals of a spark coil. The terminals were in the form of a point and a disc. The mica was quite free from oil. The potential difference of the spark coil was increased until the insulation just stood the pressure without breaking down. In this case thick radial discharge was observed going from the point to the edge of the mica. Next, a circle of oil was spread around the brass point, and with no change of potential difference in the spark coil. The inner diameter of the oil circle was about ¾ in. After the circuit was closed, the insulation broke down. It was observed that the insulation could be broken down at a much lower potential difference between point and disc, with the oil circle than without it. The same phenomenon took place if paraffine or stearine was used instead of oil.

If a drop of oil was placed right under the brass point, a forcing up of the oil around the point could be observed. One appeared as if the oil was vaporized, and the vapor increased the capacity of the conductor around the brass point. To test this a circle of sealing wax was used instead of oil. In this case the insulation broke down long before the sealing wax could be melted by the discharge, showing that a vapor was not necessary to cause the insulation to break down. A lower potential difference would break down the insulation, if a ring of sealing wax was placed around the discharging point instead of oil. The explanation of this appears to be that the oil circle is driven out by the discharge, so that the surface is larger when oil is used than when sealing wax is used.

Another investigation showed that the theory of the concentration of the electric discharge around the point, by the wall of the oil or sealing wax, is a correct one. The experiment was made in the following way:

A semi-circle of paraffine or sealing wax was placed as in Fig. 4. In this case the insulation did not break down, but the discharge



FIGS. 4 AND 5.—EFFECTS OF HIGH-POTENTIAL DISCHARGES ON MICA.

was driven out through the opening in the circle, as shown in the sketch. Without a change of potential difference in the spark coil, the circle assumed a wall shape, as in Fig. 5, when the insulation broke down in the farthest corner, *x*, showing that the electric pressure was highest at this point. This is a result of the electric repulsion of discharges of the same signs.

It was early observed that a sheet of varnished paper under the same electric pressure acts the same when placed in oil or in air,

the effect of discharging on varnished paper being thus different from the effect on mica. This is easily explained on the grounds set forth above. The distribution of the discharge causes a heat effect on the surface of the varnished paper, the varnish melts and acts like a ring of melted sealing wax on the paper. In this case a drop of oil made no difference, since the electric pressure per unit surface was already sufficiently high to break down the paper. In other words, the density, $de \div df$ was high enough to break down the insulation.

Investigation with sealing wax on varnished paper gave quite the same result as on mica. Varnished paper thus breaks down with a lower potential difference than a like sheet of mica, and this when the insulating property of varnished paper exactly equals that of mica.

The result of the whole investigation goes to show that a solid insulation combined with mica in condensers or similar apparatus, would be most effective without the use of oil. The details of the apparatus would, however, be more complicated in this case, but a good insulating jelly would serve the same purpose without making the repair of the apparatus difficult. Air bubbles in the insulation must be avoided, because the discharge will always pass through an air bubble.

Parallel Operation of Direct Connected Alternators.

BY P. C. OSCANYAN.

Some experiments made last year (see issue of September 13, 1902) demonstrated that the successful operation in multiple of alternators directly connected to Corliss engines is dependent upon the frequency of the oscillation which results from the synchronizing power of the generators, in combination with the moments of inertia of the revolving parts of the unit. It was found that when a balance existed between these two factors an equilibrium results which is most difficult to maintain. Also, that when the effect of the moments of inertia predominated the frequency of the oscillation is decreased, and when the synchronizing power predominated the frequency increased.

During the past year we have discovered that successful operation may also depend upon the amplitude of the oscillation, which in turn has been found to be dependent upon the sensitiveness of the governor, the number of cylinders of the engine and the dampening effect of the generator field. The more sluggish the governor, the fewer the cylinders and the greater the dampening effect of the field producing an oscillation of minimum amplitude, so it now appears that successful operation depends upon both the frequency of the oscillation and its amplitude, both of which are dependent upon the component effects of the characteristics of the generator and engine. We are, therefore, compelled to admit that it is impossible to design a generator to operate successfully in multiple unless the characterictics of the engine to which it is to be connected are known, and vice versa.

Furthermore, the old stereotyped phrase of engine specifications, which states that the variation in angular velocity shall not exceed a certain limit, must be entirely disregarded; for if the generator is not so designed as to conform to the characteristics of the engine, the generators will build up and multiply any variation in angular velocity of the engine until a point is reached where they will go out of step. Therefore, to be consistent with intelligent engineering, it is necessary to treat the design of the unit as a whole, predetermining the frequency and amplitude of the oscillation. It is, however, safe to state that ninety-nine units out of a hundred will successfully operate in multiple if the fields of the generators are properly provided with dampening devices, as it would only be in the case of units having excessively light wheels that satisfactory results could not be obtained; but since the proof of the pudding is in the after effects, it may be interesting to state that the two units considered in an article in this journal under date of September 13, the variation in angular velocity of which was then analyzed have had their faults rectified by placing dampening devices upon the pole pieces of the fields, so that they now run more perfectly in multiple than any two units ever observed by the writer. This opinion is based upon the fact that the two units operate perfectly without the aid of any friction device upon the governors, which are permitted to run free.

In this particular case the characteristics of the generators and engines produced an equilibrium or balance of unity which, the writer does not hesitate upon being put on record as stating, could also have been overcome by unbalancing the fly wheels. Such an expedient, however, could hardly be considered good engineering, and while it would accomplish the desired result, should not be resorted to without first making the most careful calculations as to the strength of the wheel and its factor of safety.

Annual Convention of the Iowa Electrical Association.

THE Iowa Electrical Association held its annual convention this year at Davenport, Iowa, April 8 and 9. This is one of the best of the State electric light associations, as shown by the number of central station men in attendance. About thirty Iowa central station companies were represented. The first session was held Wednesday morning, April 8. President W. J. Greene, of Cedar Rapids, called the meeting to order and Secretary W. S. Porter, of Eldora, read the minutes of the last meeting and executive committee meeting. President Greene made a short address in which he said that the objects of the association were to promote the common interests of its members by coming together and discussing station topics and exchanging ideas and experiences, and in gathering data. In his opinion, the membership of the association should include not less than 100 central station companies. The work of the association had been organized according to the plan of having certain members each investigate specially certain particular subjects and collect data on them. This had worked well and resulted in the compilation of considerable valuable information. He thought the idea could be carried still further to advantage. For example, he had been collecting the results of tests made by various companies on different makes of meters, showing the number defective when new and the number defective after a period of use.

No definite details were given, but further figures were promised for the next meeting, and the subject was cited as an example of how companies might compare notes as a guide in purchasing apparatus, and eliminating poor supplies. Among recent features of interest to the central station owner as being likely to broaden their field were mentioned the Nernst and mercury vapor lamps and the Bremer arc lamp.

Treasurer George S. Carson, of Iowa City, made his report, showing receipts during the year of 6429.40 and a balance of $169.20. A nominating committee was appointed to report the next day.

Mr. W. S. Porter, owner of the Eldora Electric Light Company, made a report on the price received for street arc lighting by various companies in the State. He had received particulars from 77 companies in Iowa and the results had been put in tabular form showing the price received for street lighting reduced to a kilowatt-hour basis, the cost of fuel, and kind, number of years' term of contract, number of hours lamps were in service, kind and capacity of lamps used and price per month. The report showed that the price paid per ton for coal varies all the way from $1 to $3.50, according to the distance from the mine and the quality used. Figured on a kilowatt-hour basis, the lowest price received for street arc lighting is .033 per kw-hour and the highest price .177. Out of the 77 companies, 19 are using alternating-current series enclosed arcs in whole or in part. Fifteen of these use the alternating-current series arc lamp exclusively for street lighting. Thirteen small companies are using alternating-current, constant-potential arcs. Direct-current series open arcs still are in the large majority, as would be expected. The remainder is divided among enclosed series arcs and direct-current, constant potential arcs. The figures will prove of considerable value to the members in the renewal of city contracts, as it puts definite figures in their hands as to what is being done in 77 towns in the State. One of the greatest troubles members of the association have had in renewing city contracts in the past has been the ignorance of city councils as to the prices generally paid elsewhere for street lighting. Some of the very low figures are usually brought up on such occasions, and the central station manager cannot be too fully equipped with data. This report will be published in full in the association proceedings to which members are entitled. A report on street lighting by incandescents, giving the price received and other particulars was also presented in an incomplete form, and is to be completed in time for the published proceedings.

WEDNESDAY AFTERNOON SESSION.

The Wednesday afternoon session was opened by a discussion of the report on street lighting data. Mr. D. F. McGee, of Red Oak, asked for an expression of opinion from the members as to

whether there was really any profit in street lighting at the rates given for most places on the list.

Mr. N. J. Higley, of Burlington, thought the price for street lighting should be governed by the price of coal. When most of these prices were made coal was very low. It had since gone up and higher prices are likely to prevail.

Mr. W. S. Porter, of Eldora, outlined the form of report he had asked in compiling this street lighting data. His plant pays $1.65 a ton for fuel, has a nine-year contract, gave in the year 2,125 hours of lighting service, and operates 27 direct-current, 10-amp. open series arc lamps at a price of $5.64 per lamp per month. The receipts were .059 per kw-hour at the switchboard and .063 per kw-hour at the lamp. The lamp hours were 54,187; percentage of lamp outage, 6-10; globes broken, 23.

Mr. R. E. Lee, of Clarinda, wanted to know if he considered .063 per kw-hour at the lamp terminals a good price.

Mr. Porter said the plant was not losing money. That was about all he could say. Mr. D. F. McGee thought the price too low on 75 per cent. of the list. Prof. G. W. Bissell, of Iowa State College, Ames, said he had observed that the prices obtained for street lighting in small towns averaged less than in large, which was contrary to what one would expect from the general rules of economic production and the wholesale price of goods as compared to the retail.

Mr. Walsh, of Davenport, spoke of the unreliability of figures given out by municipal plants on cost of lighting.

Mr. Geo. S. Carson, of Iowa City, said that the cost per kilowatt-hour depended in any plant very much on the load that plant carried in proportion to its capacity. In a lightly loaded plant, the cost was high.

Mr. Austin Burt, of Cedar Falls, in speaking of the difficulty sometimes experienced in changing from open to enclosed arcs, because of the apparent lower candle-power of the enclosed arc to a casual observer, said that when he originally changed from open to enclosed arcs he used inner globes of ground glass, as is usual. There was some dissatisfaction on the part of members of the council until the globes were changed to clear glass, so that the dazzling effect of the open arc was secured, and everyone was apparently satisfied.

Mr. Walsh, of Davenport, mentioned a case his company (the Davenport Gas & Electric Company) had in court in which the City of Davenport brought suit against the company to force them to change from direct-current open to alternating-current enclosed arcs on their city contract. The court decided after hearing the testimony of experts brought in by both sides that the City of Davenport was getting as good a light as the electrical industry had to offer. The testimony of the city electricians of Chicago and St. Louis was brought in, in defense of the company.

Mr. T. W. Kelley, of the People's Light Company, Davenport, without venturing an opinion as to the relative merits of open and enclosed arcs, thought that the Davenport case in court did not really decide anything because it was simply the opinion of a judge who knew nothing of technical matters formed through the hearing of testimony of experts paid by either side. After a somewhat heated discussion of the value of the court's opinion in this case, Mr. Austin Burt summed up the matter by saying that while the open, direct-current arc gave the most light for the power expended, the alternating-current, enclosed arc was the best for street illumination because of the better diffusion and distribution, and the lower cost, everything considered, at which it could be produced in connection with commercial lighting.

President W. J. Greene, of Cedar Rapids, said that his company was gradually working from direct-current open to enclosed alternating-current series arcs. In testing the relative street illumination from the two kinds, both lamps had been installed on the street, so that every other lamp was enclosed, and every other open. The relative illumination obtained between lamps was determined by a rough oiled paper photometer moved along the street until the point of equal illumination was determined. This demonstration was for the benefit of the city officials.

Mr. H. T. Fiske, of Muscatine, then read a paper on the "Maintenance and Operation of a Central Station Using Steam Power." This paper was mainly a concise statement of the necessity of keeping regular records of coal consumed, water evaporated, and kilowatt output. Systematic records were absolutely necessary if an intelligent knowledge of where there was room for improvement was to be obtained. He enlarged especially on keeping a record of water evaporated per pound of coal in order that a check could be had on the quality of coal and on the performance of the firemen.

Mr. Austin Burt said that his company, at Cedar Falls, was evaporating 4.5 pounds of water per pound of Iowa coal and this meant at former normal prices for coal a cost of 16½ to 17 cents per 1,000 gallons evaporated. At recent abnormal prices, it meant 30 to 40 cents per 1,000 gallons. This was by water meter measurements.

Prof. Bissell said that tests carried on in a boiler plant at his institution and verified by the results in the city lighting plant at Ames showed that the lowest priced (Polk County) Iowa coal that they could obtain was the most economical, as it not only gave the most heating value for the money expended, but was of higher heat value than some of the coal imported from Illinois.

Mr. George S. Carson, of Iowa City, read a paper on "Maintenance and Operation of a Central Station Using Water Power." He gave a brief description of the plant of the Iowa City Electric Light Company on the Iowa River, about three miles from town. It is a water power plant with an auxiliary steam plant using high-speed steam engines. "W. H. C." voltage regulators are used. Such regulators are considered essential if lights and motors are run from the same circuits. Separate step-down transformers are used at consumers' premises for motors and lights, in order to keep down voltage variations. The transmission line is two-phase, 2,000-volt. Barbed wire is strung two feet above the transmission line for lightning protection. The cost of this water power plant with steam auxiliary complete, together with transmission and distribution system and transformers was about $275 per horse-power.

Mr. Austin Burt said that the cost of his company's new steam-driven plant, with distribution system and transformers, was less than half that figure, or about $125 per horse-power.

After adjournment many of the delegates visited the sub-station of the People's Light Company in Davenport, which gets its power from a hydraulic plant across the river in Moline. The plant of the Davenport Gas & Electric Company was also visited.

THURSDAY MORNING SESSION.

At the opening of the Thursday morning session an invitation was extended by the government authorities and the Tri-City Railway Company to visit the Rock Island Arsenal by special car.

The first report to be taken up was that of Mr. D. F. McGee, giving "Data on City Pumping." The information collected by Mr. McGee showed that twenty electric light companies in Iowa are doing city pumping for water works and of these five are doing it with electrically-operated pumps. Nine of these stations pump at a flat rate of so much per month. Ten have a minimum rate with a measured rate for all pumping over a certain daily maximum. One pumps at a regular rate of so much per gallon. The various information was compiled in tabular form, which gives some insight into the conditions in each case. Mr. McGee thought that "many members were either inexperienced in this class of work or were unable to secure definite information as to cost of doing it when they made their contracts for pumping. "As a result, we are doing it at a loss. Our company was one of the first in the State to attempt to do city pumping with electric power. We have been successful in saving money for the city, but our margin of profit, after figuring up cost of fuel and other expenses, interest on investment and depreciation, has not been very large. We furnish day power service and operate a heating plant; have a large standpipe and can pump water at most convenient times."

The rate at Red Oak is $125 per month minimum, with 4 cents per gallon additional for all in excess of 100,000 gallons each day. The pumps work against 100 lbs. pressure, drawing from open wells. Allowing 6 per cent. interest and 6 per cent. depreciation on apparatus, the rate received worked out practically at about 4 cents per kw-hour. The saving to the city was $1,800 to $2,000 per year.

Mr. A. W. Zahm, of Mason City, said his company had been recently figuring with the city on doing the pumping, as the city's apparatus was in need of replacement. It was now costing the city 8 cents per 1,000 gallons to pump from a deep well and then to a standpipe.

Mr. George S. Carson, reporting on the subject of lamp testing, said that arrangements had been made with the electrical department of Iowa State College, Ames, whereby energy consumption and candle-power tests would be made at $1 per dozen on lamps delivered at the college. Without some kind of checking-up test on lamps purchased, companies were groping in the dark. Prof. Bissell, of Ames, spoke a few words of explanation regarding the lamp tests.

They consisted of measuring the mean horizontal candle-power and the end-on candle-power, together with the watts consumed at rated voltage. Special tests could be arranged for at special price. He said the engineering department of Iowa State College would be glad to undertake the work of testing for central stations of the State.

Mr. G. C. Gardner, of the Mt. Vernon Electric Light Company, told of his experience in putting in meters. He put in meters on all customers last fall (he would not recommend the fall as the best time, however) and where before they had been carrying 15 to 20 amp. alternating-current load from 1 to 5 A. M., they now had only 2½ to 3 amp. during that time. They had lost but few customers, saved a lot of coal and saved on lamp renewals.

A number of members compared practice as to meter rentals. Some rent meters at 15 to 25 cents each per month, and others sell the meters to the customers, agreeing to buy them back upon discontinuance of service.

Mr. A. W. Zahm carries a blanket insurance policy on all meters and arc lamps. Mr. D. F. McGee also advocated such a blanket fire insurance policy.

In response to a question as to the legality of charging a minimum rate per month, Mr. George S. Carson said that there was no reason why a "readiness to serve" investment should not be considered, and this had been legally established in a suit brought by the New York Edison Company.

President Greene said that the Cedar Rapids franchise ordinance permitted a minimum rate. Mr. R. E. Lee, of Clarinda, said that the Clarinda ordinance recognized and specified a minimum rate. Mr. George S. Carson, returning to the subject of lamp testing, said that it must not be forgotten that it is light that the company is selling, and that the efficiency of the lamps was important. Mr. T. F. Kelly, of Davenport, said the Nernst lamp had been found very efficient, but the cost of renewals so far was rather high.

Mr. Austin Burt gave some data on his company's new plant. The plant at Waterloo was designed to furnish light and power in Waterloo and also to supply Cedar Falls as a sub-station, over 7.4 miles of 10,000-volt line. The voltage of 10,000 had been selected because it involved only the use of standard apparatus and made it possible to reach out further than Cedar Falls. Three General Electric, 75-kw transformers were at each end of the transmission line. The pole line was mainly Idaho cedar poles 40 ft. long, with 7-in. tops. They were set from 90 to 110 ft. apart. The 40-ft. poles cost $9.70 and the 60-ft. poles $14.10 each. The cost of pole hauling, setting and gaining for the cross arms averaged $2.75 per pole. This high cost was because part of the route was off the highway on soft ground. The conductors were No. 6 bare copper wire on Locke No. 1, 15,000-volt glass insulators. The cross arms were braced on one side with an iron brace. The wires formed a 28-in. triangle. The cost of the transmission line was $800 per mile. As a temporary expedient while awaiting some of the 10,000-volt apparatus, power was being transmitted over this line at 2,300 volts with 400 volts line loss, which was compensated for by induction regulators at each end and by a boosting transformer, which consisted of an ordinary 2,200 to 220-volt transformer with its secondary in series with the 2,200-volt mains.

President W. J. Greene, of Cedar Rapids, read a short paper on the "Necessity of Grounding Secondary Circuits." He gave a short summary of the actions by various bodies that led up to the recommendation of grounding all low-tension circuits in the National Code rules. The Cedar Rapids Electric Light & Power Company at first tried grounding on only part of its transformer secondary circuits. It was found that if anything, contrary to expectations, there was less trouble from breaking down of transformers on the grounded than on the non-grounded circuits. All his company's secondary circuits were now grounded with a copper plate in a bed of charcoal 5 to 10 ft. deep. In conclusion, he said it was hard to understand why companies still fail to take advantage of this sure method of securing absolute safety of consumers from dangerous high-voltage shocks. He urged all who had not done so to begin the work of grounding at once.

FINAL SESSION, THURSDAY P. M.

A short executive session was held Thursday afternoon, and officers for the ensuing year were elected as follows: President, D. F. McGee, Red Oak; vice-president, W. L. Bowers, Davenport; secretary, W. S. Porter, Eldora; treasurer, Rufus E. Lee, Clarinda. Executive Committee—The officers and Austin Burt, Cedar Falls; George S. Carson, Iowa City; N. J. Higley, Burlington. The next meeting will be at Des Moines in April, 1904.

Among those present were: A. R. Walsh, Davenport Gas & Electric Company; N. J. Higley, People's Gas & Electric Company, Burlington; G. C. Gardner, Mt. Vernon Electric Light Company; P. E. Bellamy, Knoxville Electric Company; W. A. Mall, Belle Plaine Electric Light Company; O. J. Johnson, Sac City Electric Company; F. L. White, Traer Electric Company; M. W. Hovey, Marshalltown Light, Power & Railway Company; W. C. Walters, Tama & Toledo Railway & Light Company; W. H. Scott, Grundy Center Electric Light Company; T. W. Kelley, People's Light Company, Davenport; D. F. McGee, Red Oak Electric Company; Edward Reavy, People's Light Company, Davenport; Prof. G. W. Bissell, Iowa State College, Ames; E. R. Cummings, Webster City Electric Company; A. L. Hindert, Perry Electric Power & Light Company; C. H. Hinkhouse, Tipton Lighting & Heating Company; Rufus E. Lee, Lee Electric Light Company, Clarinda; M. N. Harrison, Osceola Electric Company; W. S. Porter, Eldora Electric Light Company; H. T. Fiske, Citizens' Railway & Light Company, Muscatine; W. H. Groner, Cherokee Electric Company; Frank Bredoo, Davenport Gas & Electric Company; W. J. Greene, Cedar Rapids Electric Light & Power Company; A. W. Zahm, Brice Gas & Electric Company, Mason City; L. B. Hovey, Independence; F. J. Pfiffner, Greene Electric Light Company; R. W. Morse, Shenandoah Electric Light & Power Company; C. A. Felker, Sigourney Electric Light & Power Company; George S. Carson, Iowa City Electric Light Company; Thomas Sloss, Cedar Rapids Electric Light & Power Company; T. A. Meyers, Grinnell Electric & Heating Company; G. C. Hoyer, Nashua Electric Plant; Austin Burt, Waterloo & Cedar Falls Gas & Electric Company; Prof. D. B. Spinney, Iowa State College, Ames.

Discussion of New York Municipal Plant Scheme.

At the meeting of the legislative committee at Albany, N. Y., on April 7, to consider the Monroe scheme for a municipal electric lighting plant for New York City, Mr. John M. Bowers appeared on behalf of the Consolidated Gas Company and the New York Edison Company, to reply to statements made by Mr. R. G. Monroe, the Commissioner of Water Supply, Gas and Electricity. After first addressing himself to the gas question, Mr. Bowers turned to the subject of electric lighting, and in the course of his remarks said:

The main criticism, however, of Mr. Monroe is directed to the cost to the city of electricity as an illuminant. He states that the prices paid in the Borough of Manhattan for a 2,000-cp lamp is $146 per year; that he has secured reports from 68 cities throughout the country showing the prices paid in those cities for supplying the same with lamps of 2,000 cp, and that the average cost is $88.60 per lamp per year.

Concerning the question of electricity it is proper to say: The electric lighting companies in the city of New York have from time to time voluntarily reduced their rates to the city and private consumers without any pressure from the municipal authorities or legislative action. The cost for arc lamps in the Bronx, involving nearly 1,000, was reduced in 1902 from 45 cents to 40 cents per lamp per night, and a number of lamps in special localities in the Borough of Manhattan, for which the city had previously paid 50 cents and 45 cents per lamp per night, was reduced to the uniform rate of 40 cents.

The Edison Company also reduced the price of electric current in 1898, and at the same time modified its price schedules, so that the smallest as well as the largest consumer could obtain a discount. A second reduction was made two years later, and on September 1, 1902, the third in the series of reductions made and contemplated was announced, this change reducing the maximum price of electric current from 20 cents to 15 cents per kilowatt-hour. This reduction, in many cases 25 per cent from former bills, will amount to nearly $400,000, the entire expense of electric street lighting in the Borough of Manhattan for one year. This change will be the better appreciated when it is recalled that in Chicago and Boston, where many items of cost are lower than here, the maximum price is still 20 cents per kilowatt-hour.

On analyzing the table prepared by Mr. Monroe as a basis of comparison with bids made for electric lighting for lamps in the city of New York, we find: The electric light plants in some of the cities

so selected are operated by water power; many of them have limited light schedules of 3,500, 3,650 and 3,800 lighting-hours per year, instead of 3,950, as required by the New York schedule. In many of the selected cases, the current supplied is far less than required in New York. In almost every case the service is largely, if not entirely, overhead, with wooden poles or outriggers, and in but one case is the service entirely underground as in the Borough of Manhattan.

It is, therefore, apparent that the general figures collected by Mr. Monroe form no basis for a comparison with the fair cost of electric lights in the city of New York. The main basis of comparison, however, that is made by Mr. Monroe, both on the question of incandescent mantles and the question of electric lighting is the cost to the city of Chicago. It is claimed in his report that the cost to that city by reason of the operation of its municipal plant in the year 1902 was, for electric lighting, a total cost per lamp of 2,000 cp the sum of $53.51.

An examination of the reports of the city of Chicago, as corrected by Haskins & Sells, as to the cost per lamp for its municipal system of electric lighting for the entire period of its existence, to wit: from the year 1888 to and including the year 1900, was at the rate of $165.62 per lamp. It seems, therefore, scarcely reasonable to select a particular year in which it is claimed that the cost was way below the average as a basis of comparison. Neither can any comparison be safely made with such cost, for the reason that items aggregating a large amount are wholly omitted in preparation of the figures. On examining this question, we find that careful and exhaustive investigations have been made of the same matters cursorily covered by Mr. Monroe by other municipalities, and especially by the city of Boston. The investigation made by that municipality which led finally to the making of a ten-year contract with the Boston Electric Light Company for the supplying of electric lights to that city was in the year 1898. In the preceding year the estimate of the cost per lamp at Chicago was the sum of $87.38. Omitted items were estimated by the Boston authorities as raising this estimated cost of $87.38 to the sum of $153.03, and this latter cost, by the addition of certain items of difference existing between Chicago and Boston was increased to the sum of $154.80 for Boston conditions. This latter item would have been $170.40, had the Boston system, as is the case in the Borough of Manhattan, been entirely underground.

Accepting as correct the claim that the city of Chicago did in 1902 supply itself at a cost of $53.51, and supplying omitted items, as was done in the Boston investigation, it will be found the real cost to that city would be the sum of $119.16, and then, by correcting the same figures so as to apply to the conditions existing in Boston and New York with an underground system, it will be found that the true cost, based upon the Chicago estimate as above, is at the rate of $138.81, instead of $53.51.

There can be no doubt that the cost of supplying public lighting to the municipality of the city of New York is at least as great, if not greater than the city of Boston. The mere cost of the real estate essential for the use of the plants in the city of New York, as compared with the cost of land necessary for the same purposes in the city of Boston, will in itself considerably increase the cost of production. As an example, the land on which the Boston Electric Station is built cost at the rate of 30 cents per square foot; while the land on which the Water Side Station of the New York Edison Company was built cost at the rate of $5.75 per square foot.

While Chicago is adopted as the main basis of comparison by Mr. Monroe he also makes reference to the cost of the Detroit Municipal plant. As Mr. Monroe refers to criticisms of such report in the Electrical World and Engineer of February 28, 1903, it may not be amiss to quote the editorial on that article in the same number. (The editorial pointing out the inaccuracy of the figures was here quoted.) It may be further stated that less than ten per cent of the Detroit service is underground, the current is less, and the lighting schedule is 3,744 hours, instead of 3,950 hours, as required by the New York contracts, and over 4,100 hours as actually delivered.

This question of municipal lighting in Detroit was also carefully considered by the Boston authorities at the time of the making of the contract above set forth, and it was shown that the cost, as stated by the municipal authorities, was underestimated by leaving out a large number of items in the same manner as was done in the Chicago estimate. It is a singular fact that the estimated cost per lamp of the municipal plant in the city of Detroit for the year 1897 was the sum of $53.06 per lamp, while the estimated Chicago cost in 1902 is $53.51. The omitted items in the Detroit estimate for 1897, as found in the Boston report, raised the cost to that municipality to the sum of $111.74, and when compared with the basis of cost in Boston was increased to the sum of $134.57, which would be still further increased, if compared with an underground system to the sum of $152.45. It is thus apparent that the price bid for municipal lighting in the city of New York is at a far lower rate than it is reasonable to anticipate the city could obtain by furnishing its own electric supply.

If based upon a comparison with the cost to the Chicago authorities during the entire period of the existence of their municipal plant at the rate of $165.62 per lamp, the bids made for electric lighting in the city of New York are $19.62 better. If based upon a comparison with the cost in the year 1897 in the city of Chicago, and increased in accordance with the difference in cost by the difference in local conditions as between Chicago and Boston or New York the difference is between the sum of $170.40 and the sum bid in New York, to wit: $146, or $24.40. And even when based upon the alleged cost to Chicago in the last year of $53.51, such cost, when increased by omitted items and by comparisons with the differences in local conditions as between Chicago and New York, will be the sum of $138.81, or $7.19 less than the bid of the electric lighting company in New York.

In considering the question of the cost of furnishing gas or of furnishing electric lights in the city of New York, there must also be borne in mind the exceedingly onerous conditions under which the corporations exercise their franchises in this city. The companies are not permitted to repair the pavements which they are compelled to open themselves, but such repairs are required to be made at the company's expense by the asphalt companies, and the cost of these repairs runs from $3.09 to $6.75 per square yard, whereas the same could be reasonably done for the sum of from $2.50 to $3.50 per square yard. For replacing a granite pavement on concrete the companies are charged by the city $8 for the first square yard and $4 for the balance, whereas this work could be reasonably done for the sum of $2.50 per square yard. The companies are also compelled to employ inspectors appointed by the Department of Highways, some of whom are paid at the rate of $1,200 per annum, and the rest $4 per day. The company has also been recently advised that additional inspectors to do the same work must be obtained from the Department of Water Supply, Gas and Electricity. It is a matter of regret that these gentlemen are not sufficiently constant in their attendance upon the work to justify the lighting companies in accepting their services in place of their own inspectors. One thing is certain, and that is, that the cost at which electric light has been furnished to the city of New York by the Brush Electric Light Company, which uses three-fourths of its output for city lighting, is at a figure which, since that corporation placed its wires underground, has paid no dividends and has not produced a sum over operating expenses sufficient to meet even a reasonable allowance for depreciation.

Mr. Monroe also makes a tabulation of certain cities stated to furnish their own electric lighting. The cities so selected that furnish lamps of 2,000 cp are comparatively few in number. The first is Columbus, Ohio, which is stated to furnish 320 lamps at a cost of $47 per lamp; St. Joseph, Missouri, 70 lamps, at $70 per lamp; Allegheny, Pa., 1,414 lamps, at $74 per lamp, Jacksonville, Fla., 152 lamps at $90 per lamp. These form Mr. Monroe's basis of comparison, save the cities of Chicago and Detroit. Aside, therefore, from the cities of Chicago and Detroit, Mr. Monroe's tabulation contains no city of any large size operating municipal plants. No statement whatever is made of the condition under which these plants are operated, whether by water power and overhead or underground system, and, indeed, no reference whatever is made to any local condition. It cannot for a moment be seriously contended that any basis of comparison can justly be made upon such a small number of cities or with such meagre information. No other city has ever pretended to act on such an investigation.

The five important cities that have undertaken or seriously considered municipal ownership are Chicago, Detroit, Boston (to all of which reference has already been made), Philadelphia and Worcester. The city of Philadelphia for many years managed its own public lighting plant. Notwithstanding that gas was sold to private consumers, giving to the city the benefit of profits derived therefrom, the result was that the manufacture and sale of gas was conducted at such an enormous loss that the city was glad to abandon the same and lease its plant to a private corporation.

In December, 1901, the city of Worcester investigated the question of municipal ownership. The committee appointed to make inquiries

obtained reports from a number of municipalities engaged in supplying electricity with a municipal plant. The result of the inquiries made was that the average cost per lamp-hour of the street arcs furnished by the municipal plants in the State of Massachusetts, as shown by the reports of the board, was, for a 500-watt lamp, 4.58c. per lamp-hour.

At the present bid of the New York Edison Company, a standard arc lamp at 4,100 hours per annum costs 3.56c. per lamp-hour.

The result, therefore, of the Philadelphia, Worcester and Boston agitation justifies the conclusion that the Consolidated Gas Company has in the past and will in the future supply the city with municipal lighting of every kind at a far less expense than would result from any municipal ownership.

Mr. Bowers concluded by saying that the public lighting of the Consolidated Gas Company is less than 4 per cent of its entire business.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

DECOMPOSITION OF WATER.

The electrolytic apparatus of Garuti and Pompili, which has long been in use in Italy for the production of hydrogen and oxygen by the electrolysis of alkali hydroxide solutions, employs for the purpose of separating the gases a vertical metallic plate, finely perforated for a short space above its bottom, this plate being insulated from the electrodes and the voltage employed being too low to permit it to act as a bipolar electrode. The combined area of the perforations has necessarily been small, and the resistance of the apparatus has been correspondingly high, so that the maximum available current density at the voltage used has not hitherto exceeded 14 amperes per square foot of electrode surface.

A distinct improvement in the cell has now been made by providing the iron diaphragm plate with an aperture of largely increased area, corresponding nearly to the surface area of the electrodes, and covering this aperture on each side with a thick sponge composed of several layers of fine wire cloth. This web endures in the solution used and is found to entangle effectually the gas bubbles which would otherwise pass between the compartments and interfere with the purity of the products. The resistance offered to the current is much lower, so that the current density may be increased to 36 amperes per square foot, and the separation of the gases is said to be equally effective.

STRIPPING PLATES.

The thin metal sheets which serve as the base for receiving the deposit of copper in the electrolytic refining methods are usually produced by electro-deposition upon a polished cathode plate and subsequent stripping. To prevent marginal growths or excrescences these plates have been provided with a wooden frame; or, according to more recent suggestions, a mere scratch upon the face of the cathode has been sufficient to so alter the character of the deposit above it that the portion of the deposit within the limits defined by the

FIG. 1.—STRIPPING PLATES.

scratch could be torn away. Mr. C. J. Henry, of Perth Amboy, New Jersey, now patents a cathode plate intended to receive these temporary deposits, consisting of a sheet of copper or lead provided with a marginal flange in the plane of the metal, but of reduced thickness; this flange is perforated at intervals and a plastic insulator, as putty, is applied to opposite faces of the flange to form the frame, the plastic layers upon opposite sides of the flange interlocking through the perforations. This frame may extend slightly above the plane of the metal, which is treated according to any of the usual methods to prevent too close adherence of the deposits. The cathode plate is conveniently extended above the upper line of the insulating frame to provide for its suspension in the bath. The accompanying figures, showing the plate in elevation with the deposit partially stripped, and also in section, are self-explanatory.

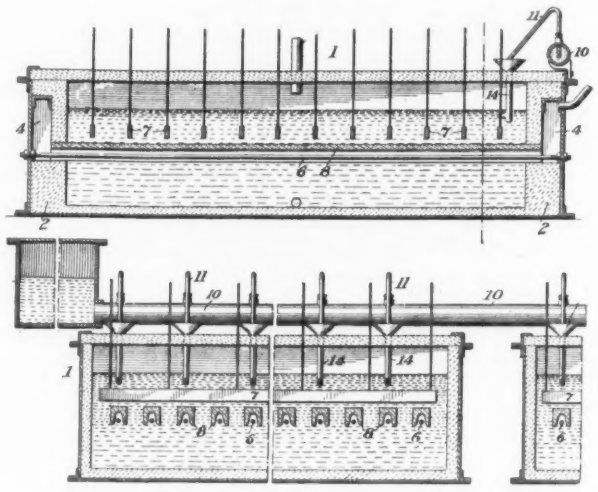
EDISON BATTERY.

Reference has frequently been made in describing the patented forms of the Edison battery to the use of flake graphite, mercury, or copper, mixed with the active material of one or the other electrode for the purpose of insuring a better contact between the individual particles of the active mass and between these particles and the metal conductor. The function of these substances being to increase the somewhat low electrical conductivity of the oxides, it is, of course, essential that they remain unoxidized in use. For this reason mercury and copper are used only in that electrode which is oxidized on discharge, whereas graphite may be employed in the electrode which is oxidized in charging and which is therefore subjected to stronger oxidizing conditions than could be borne without change by the metals.

In other words, the cell may comprise an electrode consisting of electrically active iron or its oxide in admixture with mercury or copper or both, opposed in an alkaline electrolyte to a composition consisting of nickel oxide and flake graphite. The best results follow from the use of mercury in quantity equal to one-fourth the weight of the iron, but on account of the high price of mercury it is more economical to use but 6 per cent of this metal mixed with 30 per cent of copper and 64 per cent of iron. The mercury in this case amalgamates with the copper and protects it from surface oxidation, and the quantity of iron used is such that it is somewhat more than equivalent to the oxidizing capacity of the nickel, whereby further protection of the mercury and copper from oxidation is afforded.

CAUSTIC CELL.

A cell patented to Rudolph Johanns, of Brooklyn, and assigned to Friedrich Junge, of Silver Lake, New York, is intended for the production of caustic soda and chlorine by the electrolysis of alkali chloride solutions, and belongs to the gravity type which employs neither mercury nor a porous diaphragm for the separation of the products. Instead, dependence is placed for effecting the separation of the products upon the differences in their specific gravities, and therefore the question of importance becomes one of design, the parts being so combined as to obviate to the greatest possible extent the formation of currents of liquid due to the escape of gases, the impoverishment of the electrolyte, or any other cause. This may be



FIGS. 2 AND 3.—SECTION VIEWS OF CAUSTIC CELL.

said to involve three conditions; the withdrawal of the hydrogen from a point immediately above the cathodes, the placing of the anodes above the cathodes and near the surface of the electrolyte, and the distribution of the inflowing brine over the surface of the electrolyte in such manner that it will mingle evenly with the main body of the solution. The caustic is withdrawn from the lower portion of the cell.

As illustrated in longitudinal and transverse section in the accompanying figures the cell comprises a lined tank 1, 2, provided with a series of horizontal cathode bars 6 traversing the entire tank and secured to its iron sheathing. Each cathode bar is surmounted by an inverted glass trough 8, which is arranged to collect the hydrogen and conduct it to chambers 4 formed within the cement end walls of the cell. The anodes, 7, of platinum or carbon, are placed above the

cathodes, and are arranged transversely of the latter, in order to diminish as far as may be the convection currents due to impoverishment of the solution around the electrodes. The fresh brine is drawn form mains 10, and is introduced into each cell through a series of adjustable siphon-tubes 11, by the raising or lowering of which the flow may be regulated, and may, if necessary, be reduced to a drop-by-drop feed whereby the electric circuit between successive cells may be broken. These siphons discharge into inlet tubes, 14, each of which is provided with a horizontal discharge nozzle immediately beneath the surface of the electrolyte.

New Telephone Patents.

A patent covering a message counter containing rather novel features was issued March 24 to G. A. Long and assigned to the Gray Telephone Pay Station Company. This counter is of the type which is located at the subscriber's station and operated by the subscriber by means of a knob or key. The sounding of a gong or bell accompanying the registering of one count notifies the central office operator that the proper registration has been made.

There are two obvious ways in which a subscriber might try to falsify his count: First, by turning back the register after the signal is given, and second, by causing the signal to sound by means other than the key. Both of these are guarded against in this counter, as the operating tumbler engages the gong-striking hammer at all times in such a manner that a reverse movement of the key is impossible, and as the gong is provided with a damper which is only raised just after a count has been made, it is necessary to make a count before the gong can ring.

The Patent Office issue of March 31 contained three patents relating to telephony. The subject of one is a new party line system, the patentee being E. A. Terpening, of Geneseo, Ill. This is based upon dividing the generated alternating signal currents into two sets of impulses, one positive and one negative, either of which may be used at will. The bells are not wired directly to the line, but are in local circuits controlled by selectors. These selectors are very similar in type to the ordinary magneto bell, but instead of having a hammer, the armature rod connects with the piston of a dash-pot, which renders motions of the armature sluggish, and thus it is not responsive to alternating currents. The armature on moving in one direction closes the local bell contacts, this in response to impulses of the proper polarity. Motion in the opposite direction has no function. A biasing spring is provided to cause the armature to return to the middle position when not actuated by current. Such an arrangement allows of four selective parties and of a considerably larger number of parties upon a hybrid "selective code-ringing" system. The presence of the liquid damper appears, however, to be decidedly objectionable.

Of the remaining patents of March 31, one describes a combined telephone, fire alarm and burglar alarm system, the invention of B. O. Fox; and the second a telephone apparatus for military field service. This is the invention of Captain Edgar Russel, of the United States Army. In his combination system Mr. Fox arranges his circuits so that in case of fire a thermostat will set a call box in operation. This sends an alarm to central on a single-stroke bell, rings a continuous signal at both central and the subscriber's premises, and in addition throws the central office drop. The burglar alarm through a relay performs these same functions except that the code alarm is omitted.

Captain Russel's telephone patent emasculates to the merest rudiments the apparatus of a telephone system. No bells are provided, but a stylus connected to one side of the battery may be rubbed along a serrated surface connected to the line. This results, through the action of an interposed inductance coil, in high-potential current impulses. These produce a buzzing in all receivers connected to the line which serve as a call signal.

In the patent issue of April 7 there are four telephone patents. Of these the most important is probably that for a "Signalling Apparatus" granted jointly to W. H. Dean and F. W. Dunbar, and assigned by them to the Kellogg Switchboard & Supply Company. This apparatus is designed for local battery systems and embraces the combination of a special hook switch and induction coil with grounded drops in a manner such that the drop signals are operated by the mere motion of the hook switch lever.

Fig. 1 shows the elements of the invention. The usual telephone induction coil is shown at *m*, while the special signalling coil is shown at *r*. At the central office is shown at *c* a grounded line drop wired to one side of the line, and at *c c'* are shown two clearing-out drops wired respectively to the neutral points of the two sides of the repeating coil. When the receiver hook rises in the usual manner, springs, *h* and *h'* making contact, close the battery circuit through the primary, *r*. This causes an inductive "kick" of moderate strength to issue from the secondary, r^2, to ground in one direction, and through the spring, h^2, pin, e^2, hook lever, *e*, spring, f^2, and wire, 3, to and through the line, *a*, and drop, *c*, in the other direction. This "kick" may throw the drop, but is not depended upon to do so, as its volume is held down by the rather slow magnetization of the

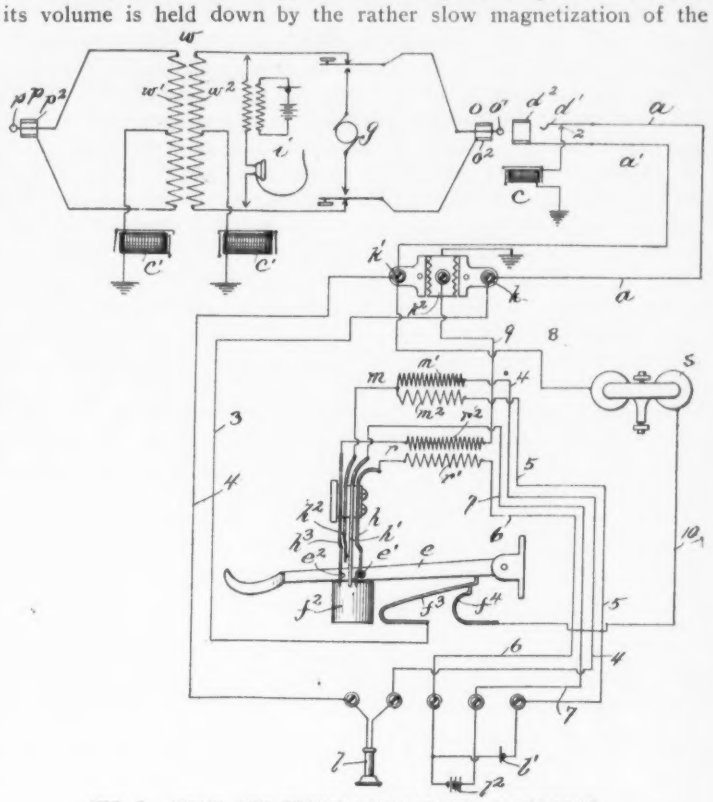


FIG. 1.—DEAN AND DUNBAR SIGNALLING APPARATUS.

core of the coil. As the hook switch proceeds, however, it soon breaks the primary circuit at the contact, *h h'*, when a second and reversed momentary current of much greater value than the first will be thrown upon the line. This current will always affect the signals. The last portion of the hook lever motion serves to cut out the signal coil completely, and to perform the usual telephone switching of receiver and transmitter circuits. Upon the depression of the hook by the replacing of the receiver a reverse order of operations takes place with exactly similar results. The inventors state and claim as one of the essential features of the system, provision for a sufficient interval between the closing and breaking of the primary signal circuit, with the normal movement of the lever, to insure the magnetic saturation of the coil core.

Some time ago a selective party line signalling system was patented based upon the Wheatstone bridge principle. In the present

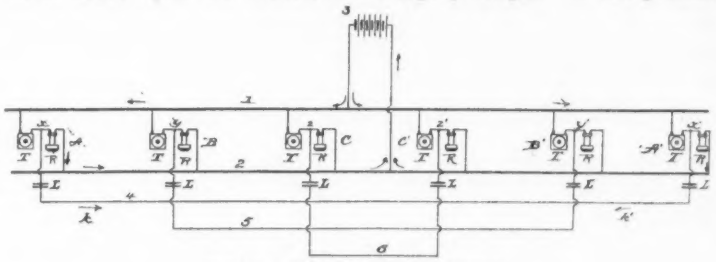


FIG. 2.—DIAGRAM OF CIRCUITS.

issue the use of this principle again appears, now applied, however, to talking circuits. Although this system has been worked out for a complete switching intercommunicating system, it is most easily discussed in reference to a diagram setting forth the merest rudiments of the circuits. Such a diagram is given in Fig. 2. It will be seen that in this diagram there are virtually three superimposed Wheatstone bridges, all using the same battery. Thus the main line wires, 1 and 2, to which the battery is connected, tap each of the

three bridges, the respective arms of which are the transmitters and receivers of stations, *A* and *A'*, those of stations *B* and *B'*, and those of stations *C* and *C'*. Each bridge has its own auxiliary, or if it may be so called, galvanometer wire. These are respectively wires 4, 5 and 6 in the diagram. Now suppose a momentary diminution of resistance occurs in the transmitter at, for example, station *A*. At once the potential of the point *x* will change and a current will flow over the wire 4 to the point *x'*, and raising the potential of that point will cause a momentarily increased potential at point *x'* and a consequent impulse through receiver *R* at *C'*. Corresponding results accompany any other changes in the transmitter resistances.

Mr. J. H. Mason, the patentee of this system, states that simultaneous conversations may be carried on over all bridges without cross talk, and this is one of the principal specified advantages. This statement does not seem to bear investigation, however, as the resistance of the line wires, 1 and 2, must have their effect. Thus the increased current to station *A* considered above will cause a readjustment of the potential drops along the line wires, 1 and 2, in virtue of their resistance, in addition to the effects already noted. In consequence there will be a fluctuation in the currents in the receivers at *B* and *C*, resulting in cross-talk. These fluctuations will have no direct effect upon the potentials of the points, *y'* and *z'*, and therefore no direct effect in producing cross-talk at stations *B'* and *C'*. There may possibly be an effect at these stations, but if so it will be due only to the impulse sent over the wire, 4, from its effect on that part of line wire, 2, between the battery and station *A'*.

"Electrical Protector" is the title of a patent issued to C. A. Rolfe, of Chicago. This device combines in one apparatus a sneak current heat coil and an open-space cut-out. The chief novelty lies in a mounting of the line plates of the open-space cut-out upon spring members secured in position by semi-fusible stops or pins. Upon the continued flow of an excessive current to ground, the pin softens and allows the plates to be violently separated by the spring mountings.

The fourth patent relates to a novel design of hook switch for desk stands. This is the invention of Charles Holmok. The switch arm is pivoted upon a non-conducting support contained within the upright of the stand. From this arm flexible contact springs are extended through guides so placed that the springs will either clear or contact with stationary terminals, according as the hook lever is moved down or up. The contact is of a sliding nature found essential in telephone practice.

Summer School for Artisans.

The Summer School for Artisans, conducted under the direction of the College of Engineering, of Wisconsin University, will open July 6 at Madison, and continue until August 14. Five sections will be organized as follows:

I. Heat, Steam, Gas, Gasoline and other heat engines. II. Applied Electricity. III. Machine Design. IV. Materials of Construction, Fuels, Lubricants, etc. V. Shop Work.

There are eight courses in the section of Applied Electricity, which includes the theory, management and testing of electrical machinery. The courses are on dynamos and motors, electric wiring, meters, transformers, lamps, telephone service, electric batteries, electric station records, elementary theory of alternating currrnts and their applications, and electro-plating and electrotyping. It is assumed that those entering are acquainted to a greater or less extent with the practical operation of electrical plants, but the lectures to be given will include such an amount of the theory of electricity and magnetism as seems desirable, or is necessary to fully explain the practical applications.

A uniform entrance fee of $15 is charged for all students taking the course, with additional shop and laboratory fees at the rate of 5 cents per hour of actual total time spent in a shop or laboratory. It is estimated that the entire outlay for the six weeks' term, including living and school expenses, may be fairly estimated at $50, not including transportation.

Two or three lectures may be followed daily in addition to laboratory or shop work, the latter being in periods of four hours daily. The students will have the benefit of the magnificently equipped university laboratories and shops, and will also have an opportunity to attend lectures at the summer session of the College of Letters and Science.

The Individual Plan of Charging for Current at Cleveland, Ohio.

By Samuel Scovil.

In the Electrical World and Engineer of September 6th, 1902, was printed an explanation of the differential system of charging for current as adopted by the Cleveland Electric Illuminating Company in 1889, of which I am vice-president and treasurer, and also some reasons for its use. As therein stated, all the lamps connected by a customer are made the basis in business places for arriving at the amount to be billed to him monthly at the base rate. I have been asked how this differential rate is adapted for use in residences by us and how it works in practice.

As every electric lighting company manager knows, it would not be fair to the consumer to take all the lamps connected in his residence as a basis for arriving at the amount of current to be billed at the base rate, for if the house be thoroughly wired throughout, all of the lamps will not be used at any one time, and even on special occasions when there is a large percentage of them used, probably less lamps than usual are used in other adjoining residences at the same time. In short, the diversity factor in residence lighting is very much greater than in business lighting. A simple way, of course, would be to take a certain definite percentage of all the lamps installed in a residence as being the demand of that residence. The objection to such a method, however, is that it would result in residences, generally speaking, not being so fully wired throughout as would otherwise be the case. To obviate this difficulty, we determined to exclude the lamps in certain parts of residences from the rating. This, of course, makes it necessary to take a larger percentage of the lamps that are included. In order to show the lamps that are included and those that are not included, we give here a copy of our rating card showing the actual rating of a residence.

THE Illuminating Company's rates for electricity to Residences are: 12½ cents per Unit until a use has been made equivalent to burning all of the lamps composing the "Residence Rating," 50 hours in each month, and 5 cents per Unit for the electricity used in excess of that amount.

As in any other meter system you pay for only the actual current used. The 50 hour use simply specifies the amount of electricity to be used at the regular rate (12½ cents) before the 5 cent rate applies.

Record of lamps affecting your "Residence Rating:"

LOCATED IN	LAMPS	LOCATED IN	LAMPS
Front Halls Main Stairway	12	Reception Rooms	10
Library Den	3	Dining Room	2
Sitting Room	10	Sewing Room Children's Room	2
Music Room Conservatory	5	Bed Rooms	15
Kitchen	2		
		Total	60

Of these lamps 7-10 are rated as 50 watt, and 3-10 as 25 watt, lamps.

This record, reported by our inspector, is equivalent to 51 Standard 50 watt lamps.

Of these 51 lamps, 4-10 only are rated, hence your "Residence Rating" is 20½ Standard lamps, which in one hour will use 1020 watts, and in 50 hours 51000 watts or 51 electrical Units.

[An electrical Unit is 1,000 watts.]

In making your monthly bills therefore, the Company will charge you at 12½ cents per Unit for any current used up to 51 Units. Any current used beyond 51 Units in a month will be charged at 5 cents per Unit—a discount of 60 per cent.

Memorandum of lamps, fans, electric heating pads, flat irons, etc., which do not affect the rating:

LOCATED IN	LAMPS	LOCATED IN	LAMPS
Vestibule Porch	1	Pantries Summer Kitchen	1
Closets	2	Servants Rooms	1
Bath Rooms Lavatories	2	Back Halls Back stairways	2
Dressing Rooms	1	Billiard Room Ball Room	
Attic Basement	2	Barn Yard	
		Total	12
		Total Lamps	72

$2.00 is the smallest sum for which a monthly bill will be rendered.

Note—The Illuminating Company is anxious at all times to co-operate with its customers in "Saving Current." Any means by which more satisfactory illumination can be secured with less expenditure of electric energy will increase the number of our patrons in proportion as your bills are reduced.

Many times there is a waste of current through faulty location or selection of lamps. The expert advice of our men in regard to this and many other points, is at your disposal, free for the asking.

Still more often the service is impaired because you use Old lamps. We furnish our customers with the best lamps on the market at very low prices and allow 8 cents rebate on each Old lamp returned to us with the filament unbroken.

RATING CARD, ABOUT HALF SIZE.

By excluding from the rating, as we do, the lamps in closets, basements, etc. etc., such lamps are installed, and the convenience of having lights in these places is an important factor in electricity being given the preference over other illuminants in the home. When we first started this rating system, we used to take the actual candle-power of the lamps included in the rating. A short experience, however, demonstrated that there was a tendency on the part of the consumer to install in the first instance 8 to 10 cp lamps entirely, so as to get the rating low, and afterwards when he found they did not give him sufficient light, as was evident to us at the outset would be the case, he would install a standard 16 cp lamp, which would result in a much larger demand than the company figured upon in arranging its basis of charge. We, therefore, concluded to asume that in all cases the lamps in the house should be rated as 7-10ths of them standard 50-watt lamps, and 3-10ths of them as 25 watt lamps. In the main this assumption has worked out satisfactorily.

In this connection, however, I beg to emphasize the fact that

whenever there is any serious complaint on the part of any consumer as to the equity of the rating as determined by the system used to arrive at it, we never insist upon it, but offer to intsall a demand meter, and to take 40 per cent. of the actual demand made as the basis for the monthly bill. The result of this policy has been that in only a few instances has the customer accepted the proposal to install a demand meter. The fact is that the method of rating used by the company, if the house be wired throughout, results in a demand for billing purposes less than the residence would secure if a demand instrument were installed upon it.

As to how it works in practice, we have been using the system now nearly four years, and with results entirely satisfactorily to the company, and with no friction being occasioned by it between the company and the consumers. There undoubtedly is some pressure on the part of consumers at times to get their rating reduced, but this has not been nearly so pronounced as we feared would be the case at the outset.

It will be noticed that I say the system has worked without occasioning any friction between the company and its customers. The fact is that in those cases where the customers have sought an explanation for our charging for current at two different rates, they very generally admit the justice of the method, and agree that the customer making the longest average use of the investment placed at his disposal is entitled to the better average rate which he earns. That the company continues to have complaints in regard to the comparative sizes of bills under this system of billing (one month with another, and one season with another) goes without saying. This would be the case under the most ideal system of billing. A "tax-gatherer" is never popular with the people from whom he collects taxes, and a lighting company is a monthly "tax-gatherer." The best, therefore, that it can expect to do in the gathering of these taxes is to collect them with as little friction as possible. It seems to me that any system which gathers taxes from the individuals in proportion to the service actually rendered them is likely to be attended with the least complaint.

In my judgment, the differential rating system for lighting companies comes more nearly accomplishing this result than any other system with which I am familiar. In practice it applies a graded scale of discounts to the customers in proportion to their use of the service they demand of it. They always get their bills at the same rate; the amounts of current used at the different rates making the difference in the average rate secured by any one customer as compared with another customer, and even as between one month's bill and another month's bill of the same customer.

Under this system of billing, the customer is charged for the same amount of current each month if he uses it, and in the heavier lighting months usually all the increase in the bill is for current used at the lower rate, so that the relative differene in the size of the bills between the summer and the winter months is not so great as where one flat rate is charged throughout the year. This is an advantage that can readily be appreciated, as it means less difference between a summer and a winter bill.

In business places a customer if he desires to be billed for current used according to the differential system is asked to make a guarantee per lamp connected per month. This is necessary for the tendency here is to install lamps for special seasons, and to use a much smaller number during the rest of the year. To such places a company cannot afford to have its lower second rate apply. In residences we do not ask for a guarantee. When a person wires his house we assume that he prefers to use electricity for illumination entirely and the differential system brings home to him forcibly the fact that when he has used in any month all the higher rate current for which the company will bill him, the lower rate current (5 cents per kw-hour) is cheaper than any other illuminant; hence it is better for him to make use of electricity throughout his house than to resort to any other illuminant. Having gotten, therefore, all the light he needs to use in his house, we do not feel the necessity of asking him for a guarantee.

The system of billing for current according to the lamps connected, as is done by the Cleveland Company, requires an inspection department, which is a source of some expense. In business places this inspection has to be thorough, and made at no infrequent intervals. In residences, however, we find that after the lamps have once been installed, it is but seldom that any changes occur in the installation, so that there is little or no inspection required in the residence part of the business. If a residence makes any material change in the lights installed in it, the attention of the meter reader is likely to be called to the fact when making his rounds, or the accounting department may have its attention called to it because of the increased use of current.

We were led to adopt this differential rating system for residences partly because of the desire to avoid the investment in demand meters, but more particularly because of the fact that we did not want to take upon ourselves the additional onus of continually verifying the correctness of any measuring instrument other than the wattmeter. One such instrument is quite sufficient. It may be interesting to know that the result of our method of rating is, that we find the total demand as arrived at by the system is equivalent to 28 per cent. of all the lamps connected in residences. When we compiled it, our idea was to take about 30 per cent. of all the lamps connected in a residence.

An objection raised by some to the lamps connected being used as a basis for arriving at the amount of current to be charged for at the higher rate is, that it prevents the installation of as many lamps as would otherwise be wired up. It does have that effect, and this may result in some loss in gross revenue, but our experience is that some check upon the installation of lamps is not altogether a bad thing. How often it happens that a party arranging for the use of electricity wires up his place profusely, and after he gets his first bill realizes that he cannot afford to use all his lamps, and then proceeds to vent his disappointment on the company, and in disgust not infrequently resorts to gas, or if he continues to use electricity, cuts out part of his installation, or uses such part only on special occasions—and special occasion lamps mean a direct loss to the supplying company.

Third Rail Methods in Brooklyn.

As the result of a report by Mr. C. R. Barnes, State electrical expert, the Brooklyn Heights Railroad Company has been directed by the State Railway Commission to place a timber between the third rail and the platform at the forty-one stations where the third rail is located on the side of the tracks.

This action is due to an accident generally attributed to the third rail, at the Fifty-second Street station of the Fifth Avenue line. Two plans were suggested for the protection of the public. One was that where the third rail is contiguous to the platform it be covered, and the second where the third rail is on the near side of the platform it be carried to the far side with wire connection with the main portion of the third rail. John B. Creighton, secretary of the Brooklyn League, laid these plans before the Board of State Railroad Commissioners, with the desire that a full investigation be made. The Commission immediately sent Mr. Barnes as an electrical expert to Brooklyn to look into the situation and make a special report.

The report states that the man met his death by being crushed between the train and the station, and further makes the following conclusions:

"The third rail at the different stations can be changed to the opposite side of the tracks. The estimated expense of this change at the forty-one stations is $11,500.

"As to the walks on the elevated structures, those on the outside of the tracks are equipped with hand rails, and these walks are necessary for the purpose of enabling passengers in times of panic in a car or when trains become stalled to leave the cars and walk to the station. If the third rail were located on the opposite side of the track from the station platforms the danger from this source to passengers leaving the cars between stations and walking to them would be very great.

"To prevent passengers falling from the station platforms and coming in contact with the third rail where it is located on the station side of the structure, the rail should be protected by an open trough extending above the top of it. But the third-rail shoes used on this system are eight inches in width, and the connections to the shoes are made in such a manner that this trough in order to accommodate the shoe and connections would have to be over twelve inches in width. This width of shoe is necessary for the operation at the Brooklyn Bridge terminus. A trough of this kind would not afford much protection against a person who has fallen from the platform coming in contact with the third rail.

"The danger from persons coming in contact with the third rail would be increased by placing it on the opposite side of the track

from the station platforms. On account of the width of the shoe and the connections to it it is not practicable to box in the third rail at the stations; but a timber could be placed between the third rail and the platforms, extending as near as possible and clear the shoe, and extending above the rail as far as the operation of the cars will permit."

It is understood that steps will be taken by the road to carry out the suggestion involved in the report, so far as possible.

Automatic Motor-Starter Litigation.

A decision recently rendered in the United States Circuit Court of the Northern Division of the Northern District of Illinois in sustaining the Blades patent on automatic motor-starters, defines the principle of *res adjudicata* as it may enter in patent litigation. The suit in question was for infringement of a patent on an automatic motor-starter issued January 7, 1890, to Harry H. Blades, of Detroit, Mich., on an application dated November 30, 1888. One of the defences was that this same patent when the subject of litigation some years ago, was declared void for want of patentable novelty. It was urged that the decision in that case was *res adjudicata,* and that the court should by way of comity concur in that decision. The court held that in view of the difference of parties in the suit at the bar and the former suit, he did not consider the claim of *res adjudicata* sustainable. As to comity, the judgment of another court upon the same subject matter is of great weight, when the same matters are presented in substantially the same manner. But if the reasoning of the court or the presentation of facts in such case fails to appeal to the judgment in view of the new presentation of the case, such judgment should prevail.

The opinion then proceeds to discuss the Walter patent, which figured in the earlier suit, and also other patents brought forward as anticipations by the defence, and concludes that the Blades patent relies for its strength on the location of the releasing magnet within the shunt motor circuit, thereby controlling the arm which contacts with the resistance sections located between the armature of motor circuits in such a manner as to provide automatically against accidents to the field circuit. The decision concludes that both the Blades combination and the result it attained were new; that the end attained was most desirable, and that the invention has gone into extensive use in a modified form, the defence having found it to their advantage to use it. The court, therefore, decided that it amounted to patentable novelty and that the patent is valid. The parties to the suit were the Cutler-Hammer Manufacturing Company and Edward W. Hammer *et al.*

A. I. E. E. Extra Meeting.

The extra meeting of the American Institute of Electrical Engineers on Friday evening, April 17, at which Mr. W. J. Hammer will read his paper, will be held at the Chapel of the College of the City of New York instead of at the Chemists' Club, as previously announced. The paper of Mr. Hammer will be one of unusual interest, not only on account of the subjects treated, but also because of the large number of experimental demonstrations that will be given. Mr. Hammer has prepared apparatus which will exhaustively illustrate the properties of radium and other radio-active substances, and of phosphorescent and fluorescent substances. Experiments prepared to illustrate the properties and application of selenium will also be of particular interest. The lecture will also deal with the treatment of disease by ultra-violet rays, to study which subject Mr. Hammer recently made a visit to the Finsen Institute in Stockholm.

Sale of Ries Patents Unratified by the Court.

On April 7 Judge Morris, of the United States Circuit Court, sitting at Baltimore, refused to ratify the sale of certain patents and patent applications granted in the name of Mr. Elias E. Ries, which sale took place March 3 by auction in Baltimore, the purchaser being Albert G. Thompson, of New York, whose bid was $60,000. In a bill of exceptions opposing the ratification of the sale, Mr. Ries alleged that his alternating-current converter electric railway patents included among those sold are fundamental and controlling, and are now being extensively used by all the larger electric railway companies in this country; that the rights to recovery for past infringement, which was included in the sale, is worth, aside from the present and future value of the patents themselves, many times more than the total price paid for the entire property. It was stated that in Greater New York alone there are now in operation and under construction electric railways involving a capital investment of over $200,000,000, which, it was alleged, have already adopted or are about to adopt the system of electrical transmission, conversion and distribution covered by some of the patents sold.

Mr. Ries further averred in his petition to the court that the prospective one-half interest in the patents held by his late associate had been previously acquired without the knowledge of the petitioner by certain parties in whose interest the entire title to the patents was eventually purchased at the public sale, and certain irregularities were charged with relation to the manner in which the preliminaries to the sale were conducted. The petitioner stated that he has secured two bidders who are willing to begin a new bidding for the patents at $120,000.

A list of the Ries patents and applications was given in the issue of March 14. One of the most important of the patents was issued to Mr. Ries April 11, 1899, on an application filed by him in 1887 after passing through interference proceedings extending over the period of twelve years. It is claimed that this patent is of such broad scope as to cover the entire modern electric railway industry. A hearing was granted at which arguments may be presented to show cause why the sale of March 3 should be set aside and a new sale ordered.

CURRENT NEWS AND NOTES.

LINEMEN AND TREES.—Gov. McCullough, of Vermont, in designating April 17 as Arbor Day, after describing the advantages to the community derived from the planting, says in his proclamation: "But besides planting, it behooves this generation to preserve. Preserve the trees by the highway from the wanton felling, cutting and slashing of the modern vandal, especially the linemen of the trolley, the telephone, the telegraph, the electric light—more destructive in their ravages than the gypsy moth or the elm beetle."

MUNICIPAL LIGHTING AT ST. JOSEPH, MICH.—An elaborate analysis of the report of the municipal electric lighting plant at St. Joseph, Mich., has been made by Mr. W. Worth Bean, the well-known manager of lighting and traction properties. He shows that nothing is allowed for depreciation, taxation, interest, insurance, etc., while sundry items of expense are wholly omitted. Even the amount of investment is incorrectly stated. Mr. Bean's company stands ready to supply lights at figures far below the actual cost of lights from the city plant.

INTERNATIONAL COMPLICATIONS.—In a recent editorial note on electroculture, we appear to have been misled as to the origin of some of the data, and thus to have located Helsingfors in Norway instead of Finland. We believe most of our readers are aware that Finland is not in Norway, but is a reluctant part of Russia, and therefore in order to avoid further international complications, we hasten to make a needed correction. We would point out that in the article Prof. Lemstroem is spoken of as a Russian, but we are not sure of his native place.

WIRELESS TELEPHONY.—A recent dispatch from London to a Montreal paper refers to some experiments made at Alexandra Palace with a system of transmitting speech and signals through the ground, the inventors being J. T. Armstrong, a Devonshire electrician, and Axel Orling, a Swedish electrical engineer. According to the dispatch, "A characteristic feature of the system was a peculiar combination of high-potential discharges and low-tension currents. Experiments with bombs proved that explosives could be syntonized within the same radius, so that all could be fired simultaneously or each in turn by means of earth currents without wires." Other experiments illustrated the transmission of Morse signals and musical sounds by a wireless telephone.

BRITISH PACIFIC CABLE.—Advices from London state that the British Pacific Cable Board estimates that there will be a loss on the working of the cable of £92,000 for the year ending March 31, 1904. This will throw a responsibility of £30,700 on to New South Wales, Victoria and Queensland. The contributors to the Pacific cable and their proportions are: Great Britain, 5-18ths; Canada, 5-18ths; New Zealand, 2-18ths; Victoria, 2-18ths; New South Wales, 2-18ths; Queensland, 2-18ths.

ELECTROLYTIC COPPER PLANT IN CANADA.—A Canadian correspondent states that within the next few months a plant will be established either in the City of Montreal or at Shawinigan Falls, Quebec, for the conversion of crude black copper into refined copper. This will be followed by the establishment of extensive works for the manufacture of the free copper into sheets and tubes. It is also reported that Mr. C. K. Milbourne, an English capitalist, has been locating a site for a plant for the refining of copper by the Cowper-Coles process.

SALE OF MUNICIPAL PLANTS.—Representative Curry, of Philadelphia, has introduced in the Pennsylvania Legislature a bill authorizing any city, town or borough owning or operating its own gas works or electric light plant to sell, or lease, or otherwise dispose of the same to individuals or corporations and to secure to the lessees or purchasers thereof by proper covenants and agreements the exclusive right to furnish gas or electricity within such city, town or borough under such regulations and for such periods, not exceeding 50 years, as the municipal authorities of such city, town or borough shall deem advantageous.

WIRELESS TELEGRAPHY FOR SUBMARINES.—A cable dispatch from London of April 11 says: In the course of experiments with the new submarines at Portsmouth an attempt was made to communicate with them by means of wireless telegraphy, which was found possible. A further trial revealed the fact that communication could only be established so long as the light penetrated to the submarine; it ceased as soon as they were submerged to a depth where the light was unable to reach them. This discovery will, it is expected, have an important bearing on the future of submarine warfare. Experiments made aboard ship to detect the approach of submarines were also successful.

WATER POWER OF THE ESCANABA.—A telegram from Negaunee, Mich., states that Minneapolis and St. Paul capitalists are planning the utilization of the water power at the falls on the Escanaba River, some thirteen miles from that city. It is estimated that 100,000 hp may be developed. A representative of the company states that one of the largest pulp mills in the United States is planned; also the transmission of power to Escanada, Iron Mountain, Menominee and Marinette. He also stated that agents of the company would be in Negaunee, Ishpeming and Marquette with a proposition to furnish power at prices much below the present cost of production.

SWEDISH BRAKE FOR ELECTRIC MOTORS.—Consul R. S. S. Bergh reports from Gothenburg, March 18, 1903: Mr. Arthur Hultqvist, assistant engineer in the workshops of the electrical street railways of this city, has recently constructed a brake for electric motors which consists of a small automatic reversing switch (omkopplare), which is fastened near the motor. On every machine is a pendant handle bearing the words "emergency brake" in red letters. If a workman should happen to be caught in the machinery or any other accident should occur, the machinery can be quickly stopped by pulling the handle, which sets the brake in action. It is claimed that the machine can be stopped in this way within one-half or one-fourth rotation.

WATER POWERS IN GEORGIA.—The Director of the United States Geological Survey, Mr. Charles D. Walcott, announces that a comprehensive system of mapping the areas adjacent to the undeveloped water powers of Georgia, which will prove to be of great value to manufacturing interests, has just been inaugurated. Careful surveys will be made of all the important streams in the State throughout their whole length, to show the amount of their fall and the position of their banks and islands; and contour maps of possible dam sites, and, finally, topographic maps of their drainage basins will be prepared. This system of surveys has been undertaken by the United States Geological Survey, and Messrs W. O. Tufts and J. R. Eakin have started work respectively on the Ocmulgee River from Atlanta to Macon, and on the Savannah River from Augusta to its head, including the Broad, Tallulah, Tugaloo and Chattooga tributaries.

ELEVATOR CONTROLLING DEVICES.—A patent issued April 7 to Mr. C. O. Mailloux on an application filed July 23, 1890, relates to Mr. Mailloux's system for controlling elevators, which has been the subject of other patents, two of which were granted in 1895. The system consists of the use on each floor of push button controlling switches in connection with locking mechanism for producing non-interference. The operation of a switch at any floor landing throws all the switches at all the landings into a temporary inoperable condition. Upon closing a switch at any landing, the elevator car ascends or descends to that landing, stopping there; all the controlling switches on the several floors are then locked, and upon a passenger entering the car and closing the door, the car is left completely under the control of the switch in the car. Upon closing the landing door after the passenger leaves the car, the apparatus is placed in such a condition that the system will be in condition for calling the car to any other landing.

MARCONI IN ENGLAND.—A special cable dispatch to the *New York World* from London of April 11 says: Mr. Marconi is disgruntled because the British Post Office still refuses him facilities for sending telegrams to his trans-oceanic wireless station at Poldhu. "The English Government is slow but sure," he said to the *World* correspondent with a tinge of bitterness in his tone. "It does not move as rapidly as the American Government does, and is not so sympathetic as the Italian, but doubtless it will do all I desire in time." The London *Times'* daily Marconigraph service has been intermittent, and this is pointed to as justification of the Post Office Department's refusing facilities to the public to offer dispatches which probably could not be transmitted. Being asked concerning the future developments of his system Marconi said: "I only forecast what I know to be certainties. I cannot commit myself to predictions which, if not fulfilled to the hour, would excite malicious criticism. My system has a future before it that will shame those who now are sceptical."

CHICAGO MUNICIPAL OWNERSHIP.—In discussing the statement of Mr. Carter Harrison, Mayor-elect of Chicago, that his narrow election is a victory for municipal ownership, the *Wall Street Journal* says: "If the policy of municipal ownership of public utilities is ever adopted in this country it will hardly be as the result of Chicago's example. The kind of municipal ownership that thrives in Chicago is not exactly the kind that the people of the country as a whole are in favor of. A city notorious the world over for its official blackmail of corporations seeking franchises is not the government to take the lead in the direction of municipal ownership. Chicago's official corruption has for years been a stench in the nostrils of honest people. Systematic blackmail has become a fine art there. Chicago must purge itself before it can hope to show to the country the advantages of municipal ownership. It is remarkable that the two cities where the idea has been tried on a large scale, Philadelphia and Chicago, have enjoyed the most unenviable municipal reputation. The first pre-requisite for the establishment of municipal ownership is municipal honesty and purity. The thought occurs to us that Mayor Harrison advocates municipal ownership in order to make it impossible for any one else to do so. If he desires a monopoly of the idea that is a good way to achieve it."

LETTERS TO THE EDITORS.

Fuel Consumption in Central Stations.

To the Editors of the Electrical World and Engineer:

SIRS:—The recent suggestions that the economy of power station operation be expressed in pounds of water used per kilowatt-hour are of doubtful value. It is true that the usual method is unsatisfactory and allows no accurate comparison of stations operating under different conditions. The pounds of water evaporated per

kilowatt-hour, including only the energy transformations in pipe line, engines, generators and cables, gives no indication, unless the pounds of water evaporated per pound of coal is stated, of the boiler room operation where the largest losses always occur. When separation is made into these two stages, discrimination between the very dissimilar performance of the engine and generator has become pertinent, and thus the real need of a simple expression for the economy of the station as a whole is not supplied. Were it not that most stations have insufficient facilities, a better practical method of stating power station economy would be pounds of combustible per kilowatt-hour or pounds of coal "dry and free from ash." The energy in one pound of combustible in ordinary coals is nearly constant, and efficiencies based on it would be directly comparable with sufficient accuracy for practical purposes.

BROOKLYN, N. Y. HARTLEY LE HURAY SMITH.

The Proposed New York State Electrical Laboratory.

To the Editors of Electrical World and Engineer:

SIRS:—We were surprised to read the report of the statements made at the hearing before the Senate Finance Committee held in Albany, March 17th, on the McEwan bill to establish a State Electrical Laboratory, particularly the references to the testing of electricity supply meters made by Mr. C. P. Steinmetz.

It has been the invariable practice of this company, and we believe of all properly conducted electricity supply companies, to test the meters in use by the consumers, upon request, at any time; and if the meter is found to be outside the limits of commercial accuracy, a prompt rebate is made to the full extent of the meter's inaccuracy, without process of law. In the regular routine of the meter department a test of all meters in use by the customers is made at least once every year. The customer is invited to be present at these tests in person or, if he desires, he may be represented by an electrical expert of his own selection.

The charter of the City of New York provides for a meter test by the Department of Water Supply, Gas and Electricity, on request of the customer, and such tests have been made in a number of cases. We believe that electrical testing laboratories of standing, conducted by private capital, are already in existence—notably the Lamp Testing Bureau, duly incorporated under the laws of the State of New York—to make electrical tests of any kind on behalf of the public on the payment of moderate fees. It is to be observed, moreover, that tests of this character should be made on the customer's premises under the conditions of environment in which the meter is actually used.

With the National Bureau of Standards at Washington, certifying to the accuracy of the fundamental standards used in meter tests, and with municipal authorities or private corporations by whom meter tests can be made, the electricity supply customer should have no difficulty in satisfying himself that his meter is recording correctly, and that he is paying for only such current as he is using.

THE NEW YORK EDISON COMPANY,
NICHOLAS F. BRADY,
Vice-President.

NEW YORK.

Electric Traction on the Swedish Private Railroads.

To the Editors of Electrical World and Engineer:

SIRS:—In an article in ELECTRICAL WORLD AND ENGINEER of March 21 the writer reported on the provisions by the Swedish Railroad Administration for adopting electric traction on the government roads. Now the "Road & Water Building Administration," to the jurisdiction of which the private railroads belong, has taken the matter up for those lines. It submitted on March 5 to the Swedish Government a petition for a grant for making tests with electric traction on a part of the Falun-Västerdalarnes Railroad. That company, from which the initiative has come, has engaged to give up a new part of its track for free use for the tests during two years, and the Stora Kopparbergs Bergslags Company will furnish, free of cost, for the same period of time, 1,100 hp from its adjacent power house. The Road & Water Building Administration has received offers to participate in these tests from the following foreign firms, viz.: Oerlikon Company, Zürich; Westinghouse Company, Pittsburg; Schuckert & Co., Nüremberg; Siemens & Halske, Berlin, and Allgemeine Elektricitäts-Gesellschaft, Berlin. They place at the Road & Water Building Administration's disposal, free of charge, an engineering staff, as well as, in some cases, rolling stock.

This test, which is going to be held in Sweden between the most prominent electric railroad systems, will, no doubt, be extraordinarily interesting to the whole electrical world.

NASHVILLE, TENN. ARVID WESTERBERG.

"Water Pail" Electric Lighting.

To the Editors of Electrical World and Engineer:

SIRS:—Referring to the interesting article by M. Paul Hoho, in your issue of March 28, I had practically the same experience as described by him, and for the same purpose, in 1894, at the East End Electric Light Plant, Pittsburg, Pa., while engaged in research on the subject of aluminum. The results obtained were communicated to Superintendent Lucas of the above plant, to a number of friends in the student course of the Westinghouse Electric & Manufacturing Company, and others.

My experiments were made with a "cell" consisting of a glass jar, with electrodes of both equal and unequal size (area of surface exposed to electrolyte) and an aqueous electrolyte, with an arc between electrodes or electrode and the electrolyte. The electrodes were cylindrical, as shape did not seem to be of consequence; and among those tested were carbon, the common metals, and metallic oxides, such as ferroso-ferric, plumbic, stannic, stannous, cuprous and cupric, both in a porous and solid state. The electrolytes investigated were water; acid, alkali and salt solution: and to prevent noxious fumes arising, recourse was had to solutions of boric acid, and similar soluble acids of the metals, salts of such acids (such as bichromates and permanganates) and soluble compounds similar to sodium-aluminate.

The use of such a method (patented several years ago) to heat or fuse metals, while accomplishing the results desired, is much less efficient than heating by the direct resistance method of metal to metal, owing to the amount of water converted into steam with consequent loss of energy, and the absorption of the gases set free by electrolysis by the metal, which causes the latter to oxidize more rapidly when exposed to the air.

I question very much whether carbon is fused, as my results tended to show that the carbon of the electrode combined with the gases set free (to form carbo-hydrides, in the case of hydrogen being evolved) and at the same time the disintegrating action of the passage of the current, which happens whether an arc is formed or not, tears from the electrode fine particles which float around in the electrolyte.

The article did not apparently comprehend investigation of the alternating current, but my experiments with both alternating (133-cycle) and direct current showed results almost the same, except that with the former electrolytic action was much modified.

The article states that "there only remains to clear the theoretical process of the imperfections inherent in all new systems." These imperfections, however, happen to be numerous, and some most difficult, among which is the great loss of the light produced due to the transformation of many of the actinic rays into heat rays during their passage through the electrolyte and the loss of energy caused by the conversion of much of the water of the electrolyte into vapor, which vapor would require some special means of removal in the case of indoor lighting, and would possibly cause trouble in outdoor lighting in cold weather.

I did not abandon the matter, but deferred it for further investigation. In view of the recent developments, I desire to state that I have found the use of such a combination (carbon, metal or composite electrodes, an aqueous electrolyte and an arc between the electrodes and the electrolyte), offers an interesting and efficient means of producing many simple and complex compounds; particularly endothermic ones, some of which are not readily made otherwise, and many only by means of the high temperatures of the electric arc. One of the simplest reactions is the production of acetylene by the use of a carbon cathode, and preferably a direct current, with a simple electrolyte such as sodium hydrate or borate, in a closed vessel; the hydrogen liberated at the cathode combines

with the latter forming acetylene (C_2H_2) and with the steam generated by the arc, and a certain amount of the volatilized electrolyte is carried over to a condenser, where the water and electrolyte is caught and the acetylene passes over to a gasometer. It may be interesting to note that there is a certain critical temperature (result of current density at the electrode) under which acetylene is not formed, and in the manufacture of other and more complex compounds, certain temperatures of the arc cause the production of other compounds than those desired. This method may no doubt prove an important factor in the ever-broadening field of electrochemistry.

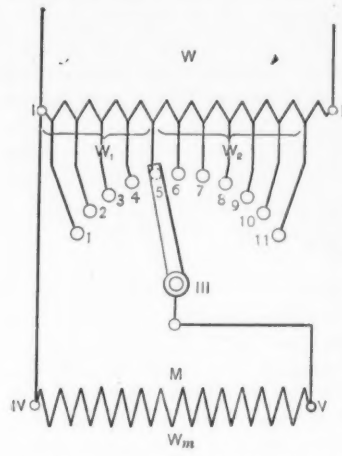
Joseph B. Hall.

Chicago, Ill.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Shunt-Regulating Resistance for Separate Excitation.—Kinzbrunner.—An article illustrated by diagrams. In some cases, especially in test rooms and in laboratories, it is desirable to accomplish a regulation of the shunt current of dynamos within very wide limits; this is especially the case in determining magnetizing curves, and in the tests of boosters. In both cases the magnets are in general separately excited and a continuous regulation is desirable. If this is done by a resistance in series, in many cases very large resistances are required. He recommends using instead, at least in special cases, the arrangement shown in the adjoining diagram, in which the regulating resistance, *W*, is directly connected to the source of the exciting current, *I* and *II*. The magnet winding, *M*, is connected at one end with *I*, and at the other end with the lever, *III*, so that the magnet winding may be connected to any part of the resistance, *W*. This arrangement has the evident disadvantage that the loss of energy is in any case greater than with a series regulating resistance. Hence this arrangement should be used only when this energy loss is of no account, and when a regulation within very wide limits is desired. This is the case for some purposes in laboratories and also in connection with boosters.—*Elek. Zeit.*, March 26.



SELF-REGULATING RESISTANCE.

Direct-Current Dynamos.—Drucbert.—A very long article in which he analyzes the design of the direct-current dynamos exhibited at the Paris Exposition and compares them with various formulas developed by S. P. Thompson, Knapp, Arnold, Picou, Fisher-Hinnen and others. In a long table he gives for 20 machines of various size and design, the principal dimensions and details of design. The various properties are then discussed and the different formulas applied. In summing up he says that in spite of difference of opinion existing between different designers concerning the principal dimensions, the number of poles, the induction and the heating limit, there are now evident uniform tendencies toward the employment of multipolar types of restricted dimensions and of a shape agreeable to the eye, towards a reduction of the diameter of the armature (due to the use of drum windings), of the teeth and of the channels for ventilation, towards the use of employing means for getting good commutation in order to reduce the wear and tear of the commutator, and finally towards the nearly general use of cast steel for the polar system.—*L'Eclairage Elec.*, March 21.

REFERENCE.

Compounding of Alternators.—Boy de la Tour.—A mathematical article illustrated by diagrams, in which he discusses the general principles and the conditions which a method of compounding must satisfy. He remarks that the use of compounding is desirable only when the variations of load which may occur are large compared with the power of the generating set.—*L'Ind. Elec.*, March 10.

Power.

A European 40,000-Volt Plant.—A note stating that the Oerlikon Company is about to erect a large electric power plant on the Caffaro River, which has its source on the Alps, forming the frontier between Italy and Tyrol, and discharges its waters into the Chiesa River. An up-stream station, which will be built later on, will supply 5,000 hp, while the station to be erected now in the Italian township of Bageline will make some 10,000 hp available. In both stations three-phase current of 9,000 volts and 42 cycles, taken from the generator terminals, will be transformed up to 40,000 volts. Current at the pressure will be transmitted to Brescia, some 40 km distant, where it will be partly used for power and light distribution in the Province of Brescia, and partly for operating large electrochemical works. The station, which is now in course of construction, has a water supply of 4,000 litres per second, with a head of 254 metres, which corresponds to an effective turbine output of 10,160 hp. The head-race has a length of 4,500 metres and includes three tunnels, one of which is 2,300 metres long. Five 2,500-hp generating sets will be installed, each consisting of a turbine directly coupled to a three-phase generator and running at 315 r.p.m. Besides these large sets there will also be two 160-hp turbines running at 600 r.p.m. and coupled to exciters. One exciter will suffice for four of the main generators, the other exciter and the fifth main set serving as reserve. The alternators are designed for 2,340 kv-amp. at a power-factor of 0.75. Five step-up transformers, each of 2,340 kv-amp., raise the pressure to 40,000 volts, and after transmission it is transformed down to the working pressure by a like number of step-down transformers.—Lond. *Elec.*, March 27.

Electric Power in Mines.—Nowak.—An illustrated description of the electric installation of the Gneisenau mine near Dortmund, Germany. Last year it was decided to considerably enlarge the existing small lighting plant so that electric current should be used for power purposes, especially for pumping. For the latter purpose a 665-hp motor was installed, which consumes about one-fourth of the whole load. The three-phase system at 2,500 volts and a frequency of 25 were chosen. For lighting and for power transmission on the surface of the earth, the three-phase currents are transformed to 500-volt, direct-current, while the pump motor, which is placed under ground in the mine, is operated directly at 2,500 volts. The plant contains two steam-driven, 625-kw, three-phase generators; two converters for excitation and lighting of 50-kw, and a direct-current dynamo of 38 kw, which was available from the old installation. The installation of the large pump motor in the mine was very difficult on account of the small dimensions of the shaft; the stator had to be brought into the mine in four parts and the rotor in two parts and both the stator and the motor had to be wound in the mine. For starting the motor two methods are used; in the first one, which is generally used, the short-circuited motor is connected with one generator which is then at rest; when the generator is started, the motor also starts and runs up to full speed with the generator. This necessitated the employment of two three-phase circuits on the switchboard, one for the normal light and power service, the other for starting the pump motor. In some cases, however, it was desirable to start the motor without first stopping one generator; for this purpose a resistance is provided in the well-known manner, to be inserted in the motor circuit; it consists of nickeline wire in oil.—*Glueckauf.*, February 28.

Traction.

Third Rail for High-Speed Electric Service.—Gonzenbach.—A summary of a paper in which the writer reviews the advantages of the third-rail system as compared with the overhead trolley, and

then takes up the several features of construction and operation of roads equipped with the former style. The practice of locating the third rail at one side of the track is commended and the necessity of adopting a standard-gauge line and elevation for surface work and elevated roads, is urged upon builders of both classes of lines. Considerable attention is given to the question of insulators, and some experiences gained on the Boston & Albany and the New York, New Haven & Hartford roads are described to show the need of adopting some other form than wooden insulators. The writer mentions that the average in a series of readings taken under his direction was between 6,000 and 7,000 ohms, and in no case does he recollect a reading exceeding 12,000 ohms per mile. In fact, very often the record shows as low as 2,000 ohms under ordinary weather conditions. Mention is made of the experiments with contact shoes to be used on protected third-rail systems, and while it is conceded that these would avoid difficulty from sleet, it is questioned whether they would be suitable in an open country where snow would be likely to drift and pack tightly between the rail and the guard. The tendency of locating sub-stations so as to get ideal power distribution, regardless of other conditions, is condemned, as is also the practice of making these sub-stations miniature power plants and "providing in them all sorts of engineering freaks in the way of apparatus." The writer, from experience, advocates as simple a design as can be adopted, and the location of these stations so as to serve for passenger and freight depots, where the men in charge may be used in other capacities than mere attendants on the apparatus.—*St. R'y Jour.*, March 28.

Surface-Contact Systems.—BORNAND.—An abstract of a paper read before the Birmingham Association of Civil Engineers. He discusses the subject under two categories: the first including systems which have a switch for each stud, placed underneath the stud, or grouped 10 or 15 together in a single box, the chief characteristic of the second system being one single switch, which commands as many as 40 studs, and which automatically distributes the current to each stud when the car is traveling. The author emphasizes the importance of sound wiring and the soldering of all the electrical joints. The effects of moisture on an electric cable carrying power for electric traction, must be carefully guarded against; a constant and forced ventilation of the tube or conduit into which the cables are drawn would be a great improvement, it would tend to keep the wiring system dry, and assure safety and avoid the danger of such an installation losing its insulation. Lead-covered wires should be avoided as much as possible, armored cables being used and enclosed in cast-iron pipes in the same way as in electric light distribution systems. Dealing with the studs and switches and the consequence of bad insulation, he advises that the switch recess should be made of incombustible material, and the insulation of the switch box and stud should be as perfect as possible. If the insulation be bad, the leakage of current with 500 or 600 volts, attains such a magnitude that an arc occurs and persists between the two contacts, rendering the stud alive. Tests with switches breaking in oil have shown them to be unsuitable in surface-contact systems. Any arcing decomposes the oil, which then forms a paste of a certain conductivity. Every possible means should, therefore, be taken to prevent the occurrence of moisture inside the switch boxes. In some systems the switch is opened by gravity, which is the simplest way; in others by magnetic influence or springs. Referring to magnets and skates, he says that if the magnetizing coils are not spaced at proper lengths along the magnetic bar, it may cause non-uniformity of the magnetic field throughout the length of the skate, and so create variable attractive forces and variable pressure between the two switch contact pieces; these bad contacts will cause undue heating and some sparking of a detrimental nature. Magnetic skates have the inherent defect of carrying and accumulating on the track all the iron particles left in the road by the wear of horseshoes and of the wheels of vehicles. The general form of safety device used on surface-contact systems consists in fixing at the rear end of the car a skate directly connected to earth through the car frame; a fuse is interposed, but it often happens that these fuses do not blow out when required, and, in the author's opinion, the only proper and reliable instrument for this purpose is the magnetic circuit-breaker. He concludes with a description of the one single-switch arrangement, which, however, is only applied to one system, known as the Claret-Veuillumier system. It is noticeable, however, that this system has only one-fiftieth of the number of switches required by other surface-contact systems.—Lond. *Elec. Eng.*, March 27.

Labor-Saving Tools.—An extended and profusely illustrated article on labor-saving tools in Baltimore repair shops. A machine is illustrated for cleaning insulation from field coils, which differs slightly from other devices of the kind. With the Westinghouse 56 field coil, the wire is so large that it is impossible to straighten it out in an ordinary machine. The coils are therefore rewound. The wire is slipped off without being straightened; the insulation is then scraped off by hand and the wire is taped and slipped back into place. The cost for labor and material of rewinding a No. 56 coil in this way is $1.50. Another illustration shows a method of winding No. 56 armature coils. The novel feature of this machine is that there is a short arm bolted to the form on which the coil is wound, and before the last quarter-turn is given the wires are bent around this arm. The result is that when the wires are cut off there are from 6 to 8 in. more slack than if they were cut off directly; this slack is just what is needed to make the first quarter turn around the machine when winding the next coil; as a result, all of the unreeling is done by machine power and none by hand. An oven for baking armatures is described, the principal novelty of which is the rack on which the armatures are carried. A car hoist is shown for use for changing trucks. The cars are run under the hoist and the bodies are raised fro mthe trucks by its means. The trucks are then taken out and new trucks are put in. A transformer is described for testing armature coils and another for testing insulation. Any voltage desired from 350 to 1,400 can be secured. Compressed air is used extensively for cleaning large motor cases and controllers. The power hammer is used, run by compressed air. The heating and ventilation of the buildings is secured by hot air; it is drawn in by blowers and forced through a nest of steam pipes and then distributed along the upper part of the buildings by galvanized pipes. The principal novel feature of the closed car is that the door is set slightly at the side, but not so far as to interfere with the use of longitudinal seats running the entire length of the car.—*St. R'y Jour.*, April 4.

Philadelphia.—WHEATLY.—A description of the tramway system of Philadelphia, which has a single-line trackage of 440 miles. Tables are given showing the receipts from passengers and other sources, operating expenses, taxes, interest on bonds, and net income. As will be seen, the transportation expenses of the company are extremely low compared with those of other companies. The company charges off 6¼ per cent. of its gross receipts for depreciation of roadway and track, 5 per cent. for depreciation of power plant, and 3 per cent. for the payment of damage and accident claims. Under ordinary conditions, these amounts are found to be sufficient. The company pays various taxes, making altogether over 8 per cent. of the companies' gross earnings. The company also carries a large part of its own fire insurance. None of the cars is provided with heaters.—*St. R'y Jour.*, March 28.

Mersey Railway.—A description of this line which runs under the Mersey River at Liverpool, and was completed in 1886, being operated by steam; it has just been electrified. The ventilating and draining systems are very elaborate and are described in detail. The power station contains three 1,250-kw and three 200-kw generators. The distribution is by direct current at 650 volts, and two third rails are used for each track. There are 24 motor cars and 23 trailers. The cars are all 60 ft. long and the trains are operated on the multiple-unit system.—*St. R'y Jour.*, April 4.

Snow Fighting.—An article on the methods used on the Buffalo tramways for snow fighting. For ordinary snowfalls the company uses a two-axle plow and for heavy snowfalls a rotary plow. The latter has two novel features. There are two sets of rotating cutters, and the body of the plow can be turned at any angle to the track, so as to cut away a high drift to a considerable extent from the track. The company is also employing a four-axle car with long wings. The prevailing wind in Buffalo is east, and it was found that if the snow on the east track of a double-track road was thrown to the east it would drift back again after the plow had passed. It was necessary, therefore, to throw the snow from the east track to the west and outside of the west-bound track. For this purpose the plow is equipped with a long wing, which, when the plow is running on the east track also cover the west track. The long wing can be folded in when a car is met.—*St. R'y Jour.*, March 28.

REFERENCES.

Lighting of Railway Cars.—GOETZE.—The first part of an article in which he discusses the various systems of electric lighting of

railway cars.—*Centralblat f. Accum.*, March 15.

New Subway in Philadelphia.—A section is given of the new subway for the electric cars under Market Street, in Philadelphia.—*St. R'y Jour.*, March 11.

Labor Clauses in Franchise Grants.—A discussion of this subject from a legal standpoint. The courts in several States have declared unconstitutional, provisions in franchises or in contracts made by municipalities calling for special hours of service and wages to be paid to laborers. The grounds for this have been "interference with freedom of contract," and "the spending of public money for other than public purposes." The same provisions have been upheld in other States. A list of cases bearing on this point is given.—*St. R'y Jour.*, March 14.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Earthing Dynamo-Electric Machinery.—BLOEMENDAL.—An article referring to a recent accident at Fulham and to the subsequent discussion on the advisability of earthing. He deals with the protective value of earthing for high-pressure systems and refers to a practice which he has adopted with the United Electric Company, of Vienna. In order to prevent any fatal interference with high-pressure machinery and apparatus, two methods may be recommended, either the use of complete insulation from earth or earthing the parts which do not carry current. The latter method is to be preferred, as by a conscientious and practical application it insures absolute safety and excludes any danger from handling the apparatus. The high-pressure machines are surrounded with sheet-metal flooring, which again is connected with earth. The earthing cable is carried round the sheeting one or two inches from the outer edge, thus forming a complete framework for the machine; only then is the earthing cable connected with the earth plate. When working with or near the machine under pressure, the workman treads on the metal flooring, which must have the same potential as the skeleton of the machine itself. Naturally, the metal flooring must be so large that a contact with the machine is only possible while standing on the metal; this should also be considered when making switchboards for high-tension installations. A similar case is that of the step-down transformer houses used in the Alpine districts of Austria, where a station furnishes high-tension current to various separate communities for lighting and power; at the place of consumption the high-tension current is transformed into one of lower pressure; usually at the place in question iron derricks are erected, the lower parts of which are formed into small transformer houses. Thus the high-pressure conductor is led within the iron structure on the masts down to the transformer by means of insulated wires. It has frequently been shown that pressure differences exist between the transformer house and the surrounding ground which constitute a danger to persons that happen to touch the house in question; this objectionable feature is overcome by placing, as in the case of the machines above described, round the transformer house an iron plate, which is earthed and electrically connected with the house itself. The metal flooring round the transformer house is covered over with earth. He thinks that these methods are preferable to that of insulating, as the maintenance of a perfect insulation is almost impossible, and a test of the excellence of the insulation appears to be very difficult, while it is easy to insure a good earthing. —Lond. *Elec. Rev.*, March 27.

ELECTRO-PHYSICS AND MAGNETISM.

Nature of Röntgen Rays.—RAYLEIGH.—An editorial note on an opinion expressed by him concerning the nature of Röntgen rays in a recent lecture on light. If Blondlot's recent observations can be accepted as perfectly reliable, whereby he found that they are polarized as usually obtained and that the plane of polarization can be rotated, then little doubt can be felt that they are really ordinary light of extremely short wave length, as was surmised by Stokes and J. J. Thomson several years ago. The wave length must be very short to yield such slight effects as have, up to the present, been observed. Of course, Blondlot's results must, till they are confirmed by other observers, be accepted with some reserve.—Lond. *Elec.*, March 27.

Intensity and Wave Length of Röntgen Rays.—HOLTSMARK.—An account of experiments in which he utilizes the secondary rays produced by the impact of Röntgen rays in order to measure the intensity of the latter. This is necessary on account of the uncertainty which attaches to their measurement by means of the photometric and ionization methods. A plate of lead or platinum is enclosed in an aluminum box and exposed to x-rays. The secondary rays produce a negative charge on the aluminum and a positive charge on the lead or platinum. On connecting the latter with the earth, a continuous current may be observed and measured; this current is directly proportional to the intensity of the Röntgen rays. The author has used this method for the measurement of the absorption of x-rays by various metals. Taking the values obtained, and using Helmholtz's theory of dispersion, he shows that the wave length of a radiation is proportional to the square root of the coefficient of absorption. In Röntgen rays, the refractive index equals unity, as it should if the frequency is about the same as the frequency of vibration of the electrons or greater than that. The values for the wave length vary according to the metal used for absorption. The highest value is 51.8 milli-microns, obtained from gold, and the lowest 2.4 milli-microns, obtained from steel and zinc. —*Ann. d. Phys.*, No. 3; abstracted in Lond. *Elec.*, March 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Copper Refining.—ULKE.—A summary of the progress made in 1902 in the electrolytic refining of copper. The world's average daily production of electrolytic copper is about 883 short tons, of which 764 tons, or 86.5 per cent., are supplied by the United States. Of the balance of 13.5 per cent., Great Britain furnished a little over 8.8 per cent., Germany about 2.75 per cent., and France a little over 1.6 per cent. The United States now produces electrolytic copper annually at the enormous rate of 278,860 tons, which at $260 per ton, is valued at $72,503,600. The copper exports of the United States consist chiefly of electrolytic copper, and for 1902 alone represented a value of $45,485,598, as compared with $33,534,899 in 1901. There are now in operation, or ready, in the world, 33 electrolytic copper refineries. The author thinks it is only a question of time when all the fine copper produced in the United States will be made electrolytically. He comments on the numerical coefficients in Philip's formulas for area, output, power, cost, current density of copper refineries noticed in the Digest last year, and believes they are not valid for the conditions in the United States, and should be largely increased, in most cases made fully twice as large. The average density employed in the 23 European refineries is less than 6 amp. per square foot, while in American refineries current densities up to 45 amp. seem to yield good copper at a profit. Under otherwise favorable conditions, therefore, the profitable use of high current densities, in order to enable the refiner to turn out copper at a very rapid rate, is seemingly limited solely by the excessive losses of current through heating, or boiling of the electrolyte, which occur with currents above 45 or 50 amp. in density. Anodes are now being cast very thick and heavy, about 400 lbs., as compared with 180 or 200 lbs. in former years; the percentage of scrap copper being then only about one-half that with light anodes, say 7 per cent., as compared with about 15 per cent. The Ottokar Hofmann method for the purification of four electrolytic solution, is discussed. He concludes with a statistical table of the copper refineries of the world.—*Eng. & Min. Jour.*, March 14.

Lead Accumulator.—M. U. SCHOOP.—A long paper in which he compared pasted (Faure) plates with Planté plates when used in buffer batteries; that is, in a service in which the battery is partially charged and discharged alternately in short intervals. The main results are as follows: The determination of the "true" total surface of a positive or negative accumulator electrode is so very difficult that it may be questioned whether it will ever be possible to determine it numerically. The apparent surface of a plate as found from length and breadth, is extremely small, compared with the true surface. With positive Planté plates the acid diffusion is better than in pasted plates, so that in very quick charges and discharges the active mass is utilized to a greater degree in the former than in the latter; but this advantage is counterbalanced by the fact that the internal resistance of a Faure accumulator, for the same capacity, acid density and density between the plates, is smaller; in buffer service the Faure accumulator is, therefore, thought to be the better. He also studied the change of weight of positive plates during charge and discharge; as the chemical reactions are the same in both cases, the differences in the behavior of both types of plates as to change of weight, represents the different conditions of acid diffusion in the plates; the results are given in diagrams, which show very clearly the difference in the conditions of diffusion

in both types of plates; the diffusion is much better in the Planté plate than in the pasted plate.—*Elek. Zeit.*, March 19.

Preparation of the Active Mass for Lead Storage Batteries.—LEIMER.—The first part of an article in which he gives an account of an experimental investigation of the value of nine different substances added to a mixture of water and lead oxides, to make the active mass more adherent and durable. The further preparation of the plates is described. The article is to be concluded and then the results will be given.—*Centralblatt f. Accum.*, March 1.

Sal-Ammoniac.—ROSSET.—A description of simple practical methods for determining rapidly the purity of commercial sal-ammoniac, which is to be used for galvanic cells. The two methods which he found most practical are to determine the specific gravity of the solution at a given concentration and the temperature decrease due to the solution in water.—*Centralblatt f. Accum.*, February 1.

Ionizing Power of Organic Liquids.—DI GIOMMO.—An account of experiments in which he studied the effect on the resistance of the mixture, produced by adding a solid insulator to an insulating liquid. Such mixtures were made by dissolving sulphur in carbon bisulphide, or naphthaline in benzol or toluol, and in every case it was found that the addition of the solid non-conductor diminished the resistance of the other, the diminution increasing rapidly at first with the percentage of the solid dissolved, and less rapidly afterwards, indicating that the resistance tends towards an asymptotic limit. If the carbon bisulphide has a resistance of 17 million megohms, 1.6 per cent. of sulphur dissolved in it reduces the resistance to 8.5 millions, 3.3 per cent. to 4.6 millions, and 16.5 per cent. to 4.1 millions. But the greatest diminution is not such as to affect the order of magnitude of the resistance. The author concludes that no real ionization takes place.—*Phys. Zeit.*, February 15; abstracted in Lond. *Elec.*, March 6.

Mineral Spring Waters and Physical Chemistry.—JUETTNER.—He discusses the abuse of the electrolytic dissociation theory and of the teachings of physical chemistry, by physicians who are in charge of mineral springs. One physician claims that dissociation takes place only in natural and not in artificial mineral waters. Another claims that a certain mineral spring is very healthful because the conductivity of its water is 6.1 times that of pure distilled water; but he does not say that ordinary water has a still better conductivity. The electric charges of the ions are credited with the healthful properties.—*Zeit. f. Elektrochemie*, February 26.

REFERENCES.

Tribelhorn Storage Battery.—An illustrated description of this accumulator, the characteristic feature of which is that the cells are cones placed one above the other, and constituting the plates, like in the old Voltaic pile. The saving of space is claimed to amount to as much as 50 to 75 per cent. The installation of such a battery in a lighting plant is described; it gives 840 or 1,200 amp-hours if discharged in 3 or 10 hours, respectively. The illustrations also show an end cell switch of very simple construction.—*Centralblatt f. Accum.*, February 1.

Galvanic Cells.—MUGDAN.—The first part of an article on the possibility of commercial carbon cells. This part is on the principle of the galvanic cells in general, from the standpoint of the electrolytic dissociation theory and the principles of thermodynamics. He considers the galvanic cell as the most simple ideal machine for obtaining the maximum possible mechanical work from a given process in the light of the second law of thermodynamics.—*Chem. Zeit.*, March 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Micro-Magnetometer.—CREMIEU AND PENDER.—A description of a magnetometer which they have in the course of their joint researches on the magnetic effect of electric convection, had occasion to devise, and which is based upon an entirely new principle, which fits it for very delicate measurements. With the aid of an ordinary astatic combination, it is not possible to reduce the disturbance due to the earth's magnetic field down to 0.000001 electromagnetic units of field-strength, or anywhere near it. Besides, every astatic combination has a slow and continuous displacement in one direction, and due to the unequal demagnetization of the two needles, which is increased by the use of alternating discharges or current. All these objections may be avoided by using a very simple contrivance, consisting essentially of a small horizontal beam carrying at one end a vertical magnet, and at the other a brass counterweight, and suspended by a torsion thread, preferably of silver, attached to its center. When the magnet is exactly vertical, the earth's force produces no couple whatever upon the suspended beam. If, now, the lower end of the magnet is introduced into the field to be measured, it is easy so to arrange matters that the upper end should be practically unaffected by the field. The authors have been thus enabled to obtain a deflection of 68 mm for a field of 0.00001 C. G. S. units.—*Comptes Rendus*, March 9; abstracted in Lond. *Elec.*, March 27.

Electric Thermostat.—MARIE AND MARQUIS.—A description of a simple and easily regulated thermostat in which a vessel contains distilled water heated by means of a platinum wire placed at the bottom of it. The regulation is effected by means of a wide glass tube filled with acetone, and acting as a liquid thermometer. The thermometer tube bends down into a vessel filled with mercury and communicating with a mercury reservoir. As the temperature rises, the acetone depresses the level of the mercury and thereby breaks the contact between a platinum wire and the surface of the mercury. The current through the platinum wire works a relay, which in turn controls the heating current. An electrically-driven turbine keeps the water at a uniform temperature. The box containing the water is surrounded with wood shavings to prevent loss by radiation. The level of the mercury surface and through it the temperature to be held constant, is regulated by means of an additional mercury reservoir, which can be connected with the first reservoir and disconnected when the desired temperature is attained. The temperature can be kept constant to within two or three-hundredths of a degree C., which means that a body placed in the bath will have a temperature constant to within 0.01 degree.—*Comptes Rendus*, March 9; abstracted in Lond. *Elec.*, March 27.

Measurement of Small Capacities and Inductances.—FLEMING AND CLINTON.—A (British) Phys. Soc'y paper. For the measurement of small capacities, when the dielectric is air or some other substance not possessing absorption, the rapid charge and discharge of a condenser through a galvanometer has been extensively used. The authors have designed a rotating commutator, which renders the measurement of small capacities as easy as that of resistance. For use with the instrument a moving coil differential galvanometer has been designed; the magnetic field at either of the coils can be varied by means of a piece of soft iron, which can be moved about in the field. They have made a number of experiments upon the capacity of arial wires, and have investigated the laws governing the capacity of such wires when grouped together in certain ways; in all cases the total measured capacity of n wires is less than n times the capacity of one wire. For the measurement of small inductances they have constructed an instrument similar to the secohmmeter of Ayrton and Perry, upon the same lines as their rotating commutator. In the discussion Campbell exhibited the commutator used for condenser tests at the (British) National Physical Laboratory; in this commutator the ebonite insulation does not fill the spaces between the segments, and is never touched by the brushes, thus giving satisfactory insulation. By its aid many measurements have been made of the Brit. Ass. air condensers, the capacity of each of these being about 0.02 microfarad. In the earlier experiments an ordinary moving-magnet galvanometer was used, but it was discovered that if the magnet at its zero position was not exactly parallel to the planes of the coils, its deflection was partly due to the mean current and partly to the square root of the mean and square current. A moving coil galvanometer was found to be quite free from such effects, and this type had been used in nearly all the tests.—Lond. *Elec. Rev.*, March 27.

Measuring the Temperature of Furnace Gases.—PRICE.—An editorial note on a paper, read before the Manchester section of the (Brit.) Inst. Elec. Eng. on the use of the potentiometer in the measurement of temperatures of flue and furnace gases. Experiments were made to show, by means of a reflecting galvanometer, in conjunction with a potentiometer and a thermopile, the recalescent points of steel and copper. He stated that his thermopile was composed of platinum for one electrode, and an alloy of platinum and iridium for the other, and with temperatures of about 2,000° F. readings can be obtained with an accuracy of 10°. The chief use to which the apparatus has been put was that of testing samples of magnet steel. In the discussion which followed, Pooley said that he had thought that the method of taking furnace temperatures by testing the resistance of a platinum coil inserted in the furnace was one mostly employed and was quite simple, seeing that the resistance

of platinum varies very evenly for different temperatures.—Lond. *Elec.*, March 27.

Standard Cells.—Jaeger.—An article on some recent researches referring more especially to the Weston cadmium standard cell. It had been found that some cadmium cells showed irregularities when used near 0° C., but this was found to be due to the use of too strong an amalgam, containing 14.3 parts (by weight) of cadmium per 100 parts of amalgam, which undergoes a change at 0°; if a slightly more dilute amalgam is used, there are no irregularities. About 80 cadmium cells at the Reichsanstalt made partly with a 12 per cent., and partly with a 13 per cent. cadmium amalgam, were tested, and although they were kept for a week at zero temperature, no irregularities were found. The supposition that the irregularity found in the cells with the 14.3 per cent. amalgam were due to a change of the electrolyte (cadmium sulphate) has been shown to be wrong, as there is no change whatever in the cadmium sulphate, and if a 12 to 13 per cent. amalgam is used, the cadmium cell is absolutely reliable and very convenient on account of its small temperature coefficient.—*Centralblatt f. Accum.*, March 1.

Miscellaneous.

Copper-Cadmium Alloys.—Denso.—An account of some experiments in which he found that the compound ($CuCd_3$) crystallizes out from all molten copper-cadmium alloys of various compositions, with an excess of cadmium.—*Zeit. f. Electrochemie.*, February 12.

Reference.

Igniters.—Armagnat.—A long article, illustrated by diagrams, in which he describes various systems of electric igniters for gas motors.—*L'Eclairage Elec.*, March 14.

New Books.

Physico-Chemical Tables. Vol. I. Chemical Engineering and Physical Chemistry. By John Castel Evans. London: Charles Griffin & Co. Philadelphia: J. B. Lippincott Co. 548 pages. Price, $8.00.

This handsomely-bound and well-printed volume of 548 pages is another one of those ever-welcome works, the preparation of which involves a great deal of conscientious and painstaking labor on the part of the compiler. The author, who is superintendent of the chemical laboratories and lecturer on inorganic chemistry and metallurgy at the Finsbury Technical College, has set himself a high standard, by designing, as he says, the work to be of use to all engaged or interested in any branch of chemistry or metallurgy—to the toiler at original research; the professor, the hard-pressed works manager, and the humblest worker in the laboratory. The aim has been throughout to save time, to bring together widely scattered information and to lighten the labor of calculation. The book is not merely a collection of tables, but contains a considerable amount of explanatory matter. Many original tables are introduced and others considerably extended and the information brought up to date. The book will prove a valuable addition to the library of any chemist or physicist. There will be a second volume, but each will be complete in the department covered.

Elektromagnetische Aufbereitung. Handbuch for Elektrochemie. By F. Langguth. Halle: Wilhelm Knapp. 64 pages, illustrated. Price, 3 marks.

This small volume is intended to be a part of the proposed large Handbook of Electrochemistry, compiled by various authors, and to be published by Wilhelm Knapp. The author gives in the short space of 64 pages a condensed review of the history and principles of electromagnetic ore dressing, the various types of magnetic separators and some results obtained by magnetic separation. He is thoroughly conversant with the subject, due to his connection with the Mechernischer Bergwerksactien Verein, the constructors of the Mechernich separators. The section on magnetic separators is treated from their historical development and the discussion of the various types is very brief and lacking in detail. Separators for strongly magnetic materials are only shortly dealt with and most of the space is devoted to a description of several constructions of Mechernich and Wetherill separators for feebly magnetic material. As an interested party, the author does not venture to give an opinion on the superiority of these last two types over each other, but hold that only practical results on a large scale can decide that question. The little volume, coming as it does from a practical man, is well worth reading, and comes at an opportune time, as much interest is being taken in the matter of separating feebly magnetic substances. It is to be regretted that the subject has not been treated more in detail.

Books Received.

La Tecnica Della Correnti Alternate. Vol. I. Parti qualitativa e descrittiva. By Giuseppe Sartori. Milan: Ulrico Hoepli. 336 pages, 260 illustrations. Price, 8 lire.

Public Lighting by Gas and Electricity. By W. T. Dibdin, F. I. C., F. C. S. New York: D. Van Nostrand Company. 537 pages, 216 illustrations. Price, $8.00.

Die Bahnmotoren fur Gleichstrom. By M. Muller and W. Mattersdorff. Berlin: Julius Springer. 418 pages, 231 illustrations and 11 plates. Price, 15 marks.

Correnti Electriche Alternate. Semplici, bifasi e trifasi. Manuali Hoepli. By Attilio Marro. Milan: Ulrico Hoepli. 615 pages, 217 illustrations. Price, 6.50 lires.

Elementare Vorlesungen uber Telegraphie und Telephonie. By Dr. Richard Heilbrun. 3 lieferung. Berlin: Georg Siemens. Complete work, 11 marks.

Die Funkentelegraphie. By C. Arldt. Leipzig: Theod Thomas. 72 pages, 75 illustrations. Price, 1.80 marks.

Descriptive Geometry. With numerous problems and practical applications, and a quarto atlas of 18 plates. By William S. Hall, C. E., E. M., M. S. New York: D. Van Nostrand Company. 76 pages and portfolio of 18 plates. Price, $3.50.

Die Grundgesetze der Wechselstromtechnik. By Dr. Gustav Benischke. Braunschweig: Frederick Vieweg & Sohn. 141 pages, 113 illustrations. Price, 4.20 marks.

Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. Next meeting, New York, April 16, 17 and 18, 1903.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting, April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa. Seventeenth annual convention of the Supreme Council of the United States, Pittsburg, May 11.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Electrical Contractors' Association of New York State. Secretary, Wm. J. Davis, Ithaca, N. Y.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary. A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association. F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

National Association of Manufacturers. Secretary, Marshall Cushing, 170 Broadway, New York. Annual convention, New Orleans, La., April 14, 15 and 16, 1903.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich, July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May 26, 27 and 28, 1903.

NEW YORK ELECTRICAL SOCIETY. Secretary G. H. Guy, 104 Liberty Street, New York.

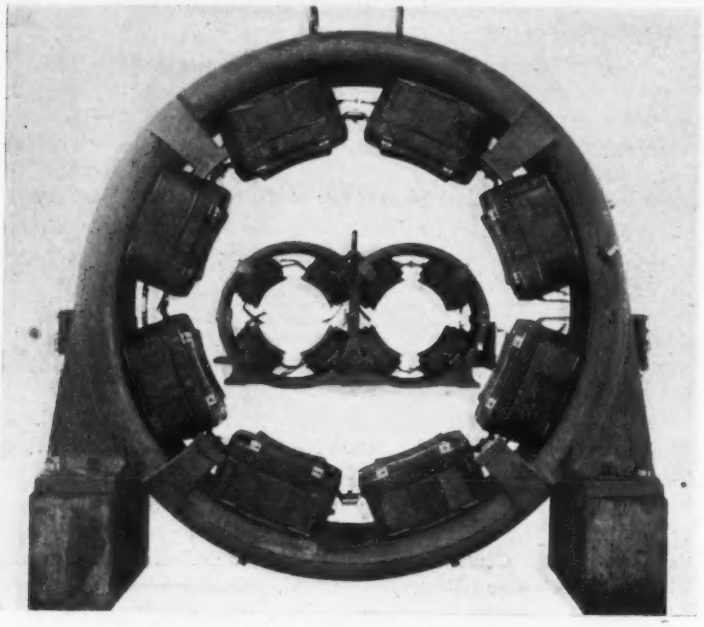
NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

SOUTHERN INDIANA TELEPHONE ASSOCIATION. Secretary, E. W. Pichardt, Huntingburg, Ind.

Turbine vs. Reciprocating Engine Generators.

BY DAVID HALL.

The public in general has learned to know that the output of a machine is increased as the speed is increased. At the same time, the fact that the frame of a 200-kw may be placed within the frame of another machine of the same rating may be worthy of notice. The development of the steam turbine has given birth to a demand for high-speed dynamos. Fig. 1 shows the frames and poles of a 200-kw dynamo at 100 r.p.m. and a 200-kw machine at 900 r.p.m.



FIELDS OF TWO TYPES OF DYNAMOS.

This picture was recently taken in the shops of the Milwaukee Electric Company, where a full line of these high-speed machines is being built, as well as a complete line of standard direct-connected machinery.

The 200-kw, 900-r.p.m. generator is of peculiar construction, made especially for the De Laval Steam Turbine Company. There are two armatures, each of which is enclosed by four pole pieces. The pole pieces are of laminated steel bolted to a cast-steel magnet frame. The 200-kw, 100-r.p.m. generator is for direct connection, and is of standard construction, having laminated pole pieces and a cast-iron magnet frame. The overall horizontal dimension is 8 ft. and 3 in., while that of the high-speed machine is 6 ft. 2½ in. The difference in the weights is still more noticeable. The slow-speed machine weighs 35,000 lbs., while the high-speed machine weighs 9,500 lbs. Of this weight the large machine has 5,000 lbs. of copper, against 1,300 lbs. for the small one. In comparing the weights of these two machines it should be remembered that the large machine has a cast-iron frame, while that of the small machine is cast steel.

By reducing the above total weights to weight per kw at 100 r.p.m., we obtain 175 lbs. for the large machine and 427 lbs. for the small machine, which means that there is 2.44 times as much material in the small machine per kw-revolution as there is in the large machine.

As both of these machines are for 250 volts, the full-load current is 800 amp. The commutator of the large machine weighs 2,000 lbs., and has a radiating surface of 980 sq. in. on the periphery. The total watts on the commutator being 2,875, gives 2.94 watts per sq. in. of radiating surface. As the temperature rise of the commutator was 31½° C., after full load for eight hours, we obtain a factor of 10.7° C. rise per watt per sq. in. This factor of degrees rise per watt per sq. in. might be expected to be less on the high-speed machine, due to the increased windage, especially so because the mechanical construction of both armature and commutator was made with a view of obtaining the best ventilation. This factor is 7° rise per watt per sq. in. on the high-speed machine as compared with 10.7° rise per watt per sq. in. on the low-speed machine.

The two commutators on the high-speed machine have a total surface of 905 sq. in. on the periphery and weigh 1,000 lbs. The watts per sq. in. were 3.57 and the temperature rise 25° after full load for 7 hours, thus giving the above-mentioned factor of 7° rise per watt per sq. in.

Comparing the armatures, we have a factor of 3.38° rise per watt per sq. in. on the high-speed machine and 13.5° rise per watt per sq. in. on the low-speed machine. The term "watts per sq. in." is a useless one unless it is known how it is obtained; in determining these factor in the present case the periphery of the armature core was taken as the radiating surface and only that portion of the armature winding in the armature slots was considered in determining the C^2R watts on the armature. The C^2R loss was added to the iron losses to determine the total loss on the armature.

The great difference in the above factors of degrees rise per watt per sq. in. on the armatures is very noticeable, and is mainly due to the ventilation. The speed on the surface of the large machine is 1,520 ft. per minute, whereas on the small machine it is 4,700 ft. or almost a mile per minute. As a result of this high speed there is a great volume of air forced through the armatures of the small machine with a consequent reduction in temperature. This fact emphasizes the importance of good ventilation.

Both of these machines will run from no load to 25 per cent. overload without sparking, the brushes remaining fixed.

The above results may be tabulated for convenience as follows:

Kilowatts	200	200
Volts	250	250
Rev. per minute	100	900
Overall horizontal dimension	8 ft. 3 in.	6 ft. 2½ in.
Total weight	35,000 lbs.	9,500 lbs.
Weight copper	5,000 lbs.	1,300 lbs.
Total weight per kw, at 100 r.p.m.	175 lbs.	427 lbs.
Weight of commutator	2,000 lbs.	1,000 lbs.
Temperature rise per watt per sq. in. commutator	10.7 C.	7 C.
Temperature rise per watt per sq. in. armature	13.5 C.	3.38 C.
Peripheral speed of armature in ft. per min.	1,520	4,700

This subject causes a reflection on the wide deviations of the requirements which are to be met to-day in dynamo design. Dynamos are built side by side, of the same kilowatt output but varying in speed in the ratio of nine to one; and even greater variations than this might not be considered unreasonable.

Westinghouse Turbo-Generators.

We illustrate herewith in detail the Westinghouse turbo-generator designed for direct-connection to the Westinghouse-Parsons steam turbine. Like any other rotating field machine, a turbo-generator may be wound for any practical voltage, the potential being limited only by the ability to insulate a stationary winding. The wave form is about the same as that of commercial alternators, and the high speed of the collector presents no unusual difficulty.

The available speeds for the turbo-generator are, however, approximately determined by the speed of the turbine, and its high speed in connection with the comparatively low frequencies employed—25 to 60 cycles—rather closely determines the number of poles. Thus, a 25-cycle machine must have two poles at a speed of 1,500 r.p.m., or four poles at a speed of 750 r.p.m. A 60-cycle machine at 3,600 r.p.m. may have two poles, four at 1,800 r.p.m., six at 1,200 r.p.m., and eight poles at 900 r.p.m.

The armature yoke is a solid, well-ventilated casting. As in the Westinghouse engine-type alternator, it holds a laminated yoke of soft steel. The yoke is pierced with partially closed slots and is ventilated by openings placed at intervals in the laminated mass. These openings register approximately with similar ones in the rotating field.

The high speed of the turbine also affects the design of the armature winding. As the speed is high, the voltage per conductor is high, and but few turns are required for ordinary voltages in a high-tension winding. This limitation, while convenient in high-voltage windings, sometimes limits the potentials possible in low-voltage windings. The question is more difficult in two than in four-

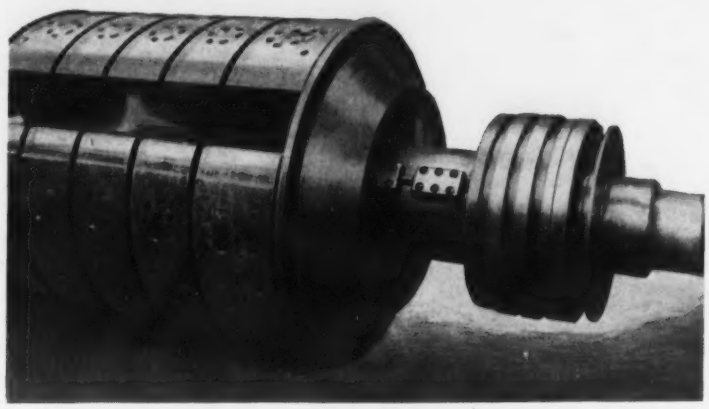


FIG. 1.—1,000-KW ROTATING FIELD.

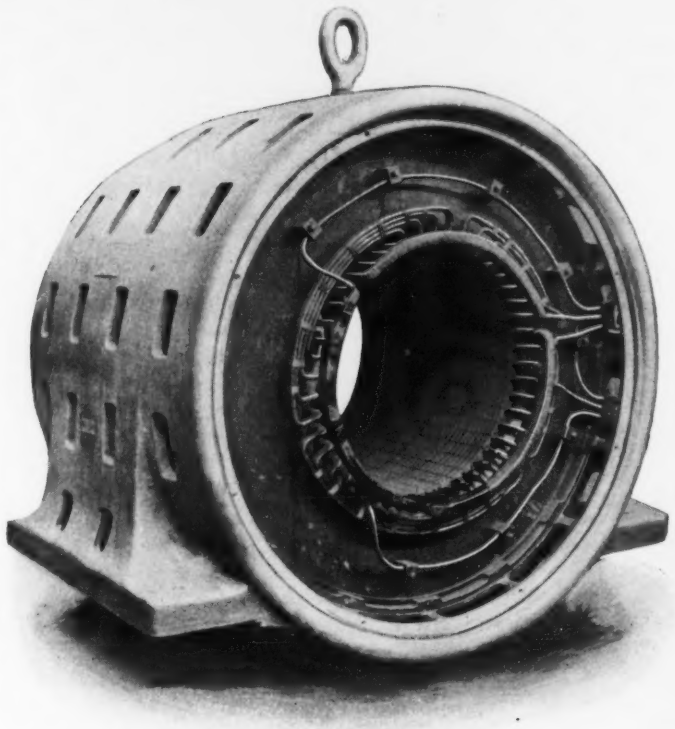


FIG. 2.—1,000-KW TURBO-GENERATOR ARMATURE, SHOWING WINDING.

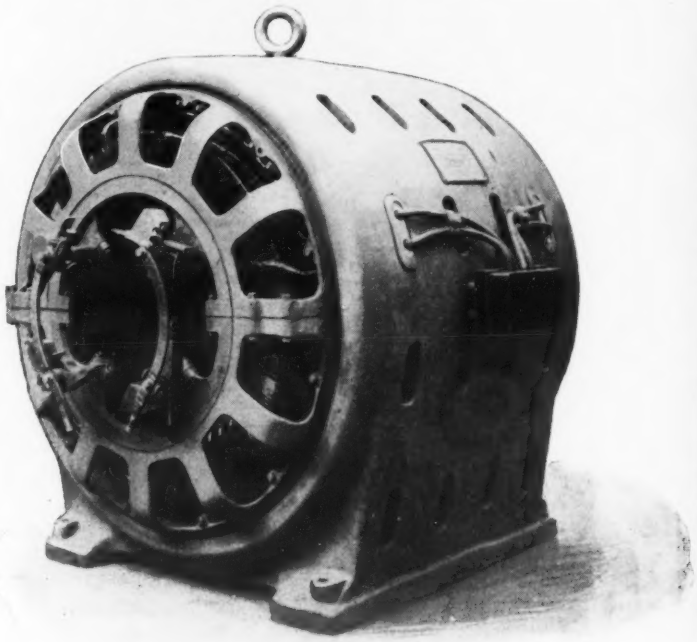


FIG. 3.—400-KW TURBO-GENERATOR, ARMATURE COMPLETE.

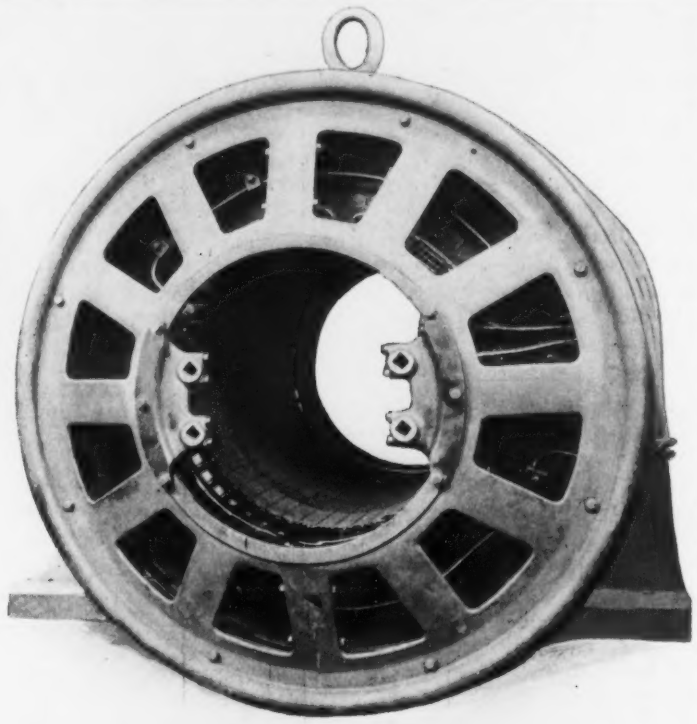


FIG. 4.—ARMATURE OF 1,000-KW TURBO-GENERATOR, UNWOUND.

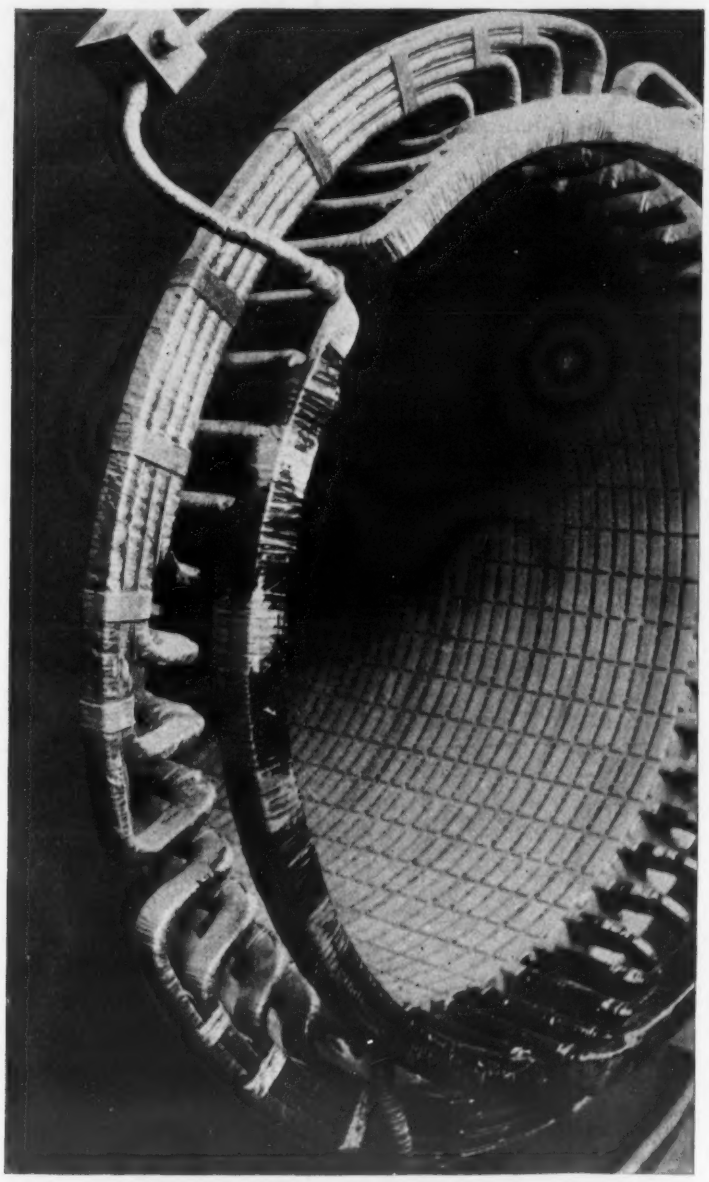


FIG. 5.—DETAILS OF ARMATURE WINDING.

WESTINGHOUSE TURBO-GENERATORS.

pole machines, because only two windings can be placed in parallel on a two-pole machine, while in a four-pole machine there are four windings to parallel for the lowest voltage.

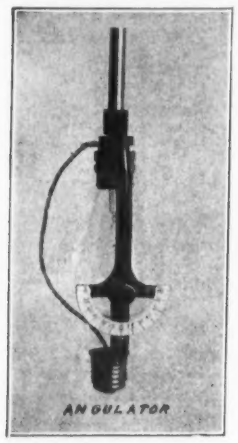
The two-pole rotating field is of solid steel, cylindrical in shape, with coils of copper strap, wound flat in grooves in the solid steel. The winding is thus subdivided and supported against centrifugal force. The grooves are afterwards closed by brass wedges and the outside of the rotating part is turned down so that it presents a smooth cydindrical surface. The smooth surface reduces windage and noise. The rotating part is provided with large air passages for cooling its windings. On four and six-pole fields, the winding is subdivided and secured in the same manner.

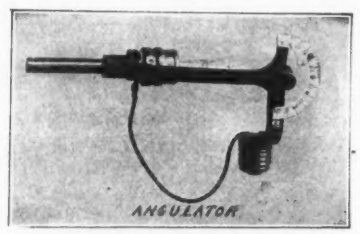
Exhibits at the Iowa Electrical Association Meeting.

A number of supply companies were represented at the Iowa Electrical Association convention. A local supply house, the Tri-City Electric Company, had an extensive exhibit on the main floor of the Masonic Temple, where the meetings were held in which exhibit many manufacturers were represented. The Western Electric Company also made a display in a store near the St. James Hotel. The companies represented were as follows: Electric Appliance Company, P. R. Boole; Kuhlmann Electric Company, E. Kuhlmann; Columbia Incandescent Lamp Company, John G. Boyd; Porter & Berg, E. R. Mason; Western Electric Company, Harry Byrne; General Electric Company, F. N. Boyer, G. A. Seabury, M. B. Beattie; Westinghouse Electric & Manufacturing Company, W. R. Pinckard, A. M. Miller, Arthur Huntington; Adams-Bagnall Company, J. G. Pomeroy; Buckeye Electric Company, J. H. Cooke, W. R. Bonham; Philadelphia Electric Manufacturing Company, C. L. Bundy; Manhattan Electric Supply Company, A. O. Einstein; Central Electric Company, J. W. Mason; American District Steam Company, J. Charles Young; Tri-City Electric Company, Edw. Kunkel; Mr. Butterworth, S. M. Howe; Ft. Wayne Electric Works, Walter Goll, E. A. Wagner and Frank McMaster; Western Electrical Supply Company, J. W. Hardy; Stanley Instrument Company, F. J. Alderson; Ewing Merkle Electric Company, O. T. Watkins; American Steel & Wire Company, B. H. Ryder.

Photometer Attachment.

It appears evident that most disinterested authorities strongly favor the method of determining the real value of an incandescent lamp as a source of light by obtaining the spherical candle-power of the lamp and considering it in connection with the actual current





FIGS. 1 AND 2.—PHOTOMETER ATTACHMENT.

required to operate it, in preference to measuring the lamp in the arbitrary manner most generally used at present, namely, for its horizontal intensity.

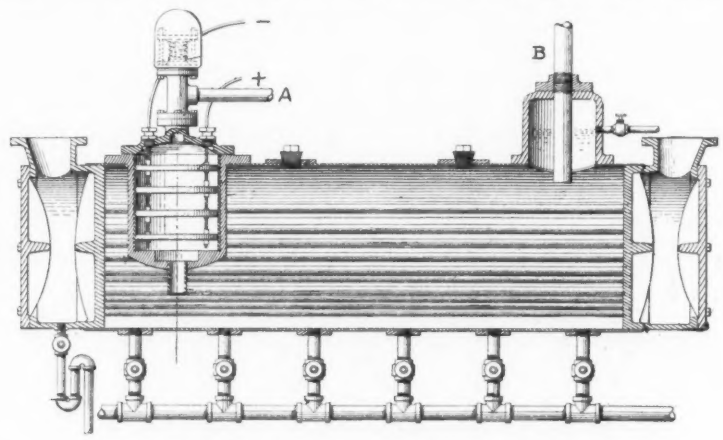
The principle argument against rating lamps by their spherical candle-power is that there has not been an instrument by which the spherical candle-power measurements can be taken at one reading that is not extremely complicated. To determine the spherical candle-power by taking numerous readings requires considerable time and is, therefore, conceded to be uncommercial. These facts do not, however, alter the true condition, and the real value of the lamp cannot be determined in any other way. In view of the expense of a photometer especially designed for determining spherical candle-power, the Shelby Electric Company has designed and is placing on the market an angulating device (see Fig. 1) which readily fits into the socket of any standard photometer. By the aid of this device the horizontal candle-power can be determined and the lamp can then be turned so that the light can be measured at any angle (see Fig. 2).

Illumination is divided into two classes, namely, general illumination and local illumination. The value of lamp for general illumination can only be determined by considering the light emitted in all directions, while by far the greater part of the light that is used for local illumination is delivered through the end of the lamp opposite the base, or within 45° therefrom. These conditions existing, the Shelby Company condemns the practice of rating the lamp solely by the light delivered horizontally, which light does not enable one to determine the value of the lamp for general illumination, and which enters into the value of local illumination only after having been reflected by walls and surfaces, the reflecting qualities of which vary. The angulator illustrated herewith has been designed with a view of placing at the disposal of owners of a photometer a method of determining the value of his lamps regardless of whether the lamp is used for general illumination or for local illumination.

Electric Process for Water Purification.

The accompanying illustration shows an apparatus invented by Mr. C. C. Clark and manufactured by the American Electric Improvement Company, Philadelphia, Pa., for the purification of water by electrical means. Referring to the accompanying illustration, the vertical cylindrical receptacle to the left contains horizontal circular perforated electrodes insulated from the sides of the cylinder by a jacket of insulating material, and supported by rods passing through insulated openings to the exterior, where they are connected to the source of current; the rod carrying one series of electrodes is insulated where passing through the other series of electrodes, by a tube of insulating material, as shown. The material of one series of electrodes is copper, and carbon that of the other series.

The water enters the cylinder through the pipe *A*, and after being subjected to electrical action between the plate electrodes, passes out at the bottom into a large horizontal cylinder from which the purified water is drawn through the pipe *B*. The sediment and impurities deposited from the water are blown off through the several blow-pipes, shown connected to the bottom. In case the apparatus is used for the purpose of purifying feed water for a boiler, the water is heated by passing the exhaust steam through the horizontal



WATER-PURIFYING APPARATUS.

tubes shown connected between heads, the exhaust being admitted in one head and discharged from the other. It is claimed that the impurities in the water are decomposed in the electrode cylinder, being finally deposited at the bottom of the large horizontal cylinder, the capacity of which is so large that the circulation of the water therein is sufficiently slow to allow precipitation. Floating impurities are discharged by a surface blow connected to the drum *B*. The voltage employed is 240, though the apparatus may be designed for any commercial voltage.

Among the applications claimed for the apparatus are the purification of boiler feed water and sewage, the purification and aging of alcoholic liquids and of water for ice plants and other potable use.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was offered freely at declining rates. The closing quotations of Thursday, when the market closed until Monday for the Easter holidays, were 5½ per cent. for 60 days; 5 a 5¼ per cent. for longer dates. There was an improving tendency in the stock market due to indications of easier money conditions, but on Thursday afternoon a heavy selling movement throughout the list followed the news that the Circuit Court of Appeals had upheld the government in the Northern Securities case and declared the combination of the Northwestern railroad lines an illegal one. The United States Steel stocks showed heaviness in spite of the favorable annual report, but had better support on Thursday. Among the industrials, a leading feature was the heaviness of Amalgamated Copper. That stock sold off on what appeared to be a liquidation of long holdings, accompanied by a withdrawal of the pool support, which had been so conspicuous in it. Brooklyn Rapid Transit was again the object of favorable reports in connection with earnings and future prospects, and showed a firm tone at a moderate improvement. Manhattan was also strong. Brooklyn Rapid Transit closed at 66⅞, being a net loss of ⅝ of a point, the highest price of the week being 69¼. Transactions in Metropolitan Street Railway were limited to 5,500 shares, this stock showing a firm tendency and closing with a net gain of 1 point, the last quotation being 133½. Manhattan Elevated closed at 138 —⅛ of a point loss. General Electric fluctuated between 187½, the highest figure, and 183, the lowest, closing at 185, this being a net loss of 1 point, and Westinghouse lost 3 points, closing at 193, after having reached 198. Western Union Telegraph closed at 85. The stock market closed on Thursday for the Easter holidays. Following are the closing quotations of April 14.

NEW YORK.

	Apr 7.	Apr. 14		Apr. 7.	Apr. 14
American Tel. & Cable	81¾	..	General Electric	185	182⅝
American Tel. & Tel.	155	152	Hudson River Tel.	..	..
American Dist. Tel.	..	30	Metropolitan St. Ry.	133⅛	133⅜
Brooklyn Rapid Transit	67⅜	66	N. E. Elec. Veh. Trns.	..	26
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	160
Electric Boat	23	23	N. Y. E. V. T. Co.	..	8
Electric Boat pfd.	37	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.	1⅛	1	Western Union Tel.	85½	85½
Electric Vehicle	12¼	10	Westinghouse com.	194⅛	185
Electric Vehicle pfd.	16	14	Westinghouse pfd.	194	189½

BOSTON.

	Apr. 7.	Apr. 14		Apr. 7.	Apr. 14
American Tel. & Tel	154	154½	Western Tel. & Tel. pfd.	97*	95*
Cumberland Telephone	..	..	Mexican Telephone	2	1⅞
Edison Elec. Illum.	285	..	New England Telephone	135	135
General Electric	186	181	Westinghouse	98	..
Western Tel. & Tel.	20	19	Westinghouse pfd.	98	..

PHILADELPHIA.

	Apr. 7.	Apr 14		Apr. 7.	Apr. 1
American Railways	..	50	Phila. Traction	97¼	97
Elec. Storage Battery	77*	75*	Phila. Electric	7	6⅞
Elec. Storage Battery pfd.	77*	75*	Pa. Electric Vehicle	..	..
Elec. Co. of America.	8⅜	8⅜	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Apr 7.‡	Apr. 14		Apr. 7.‡	Apr. 14
Central Union Tel.	..	..	National Carbon pfd.	..	97¼
Chicago Edison	..	..	Northwest Elev. com.	..	..
Chicago City Ry.	..	205	Union Traction	..	7
Chicago Tel. Co.	..	..	Union Traction pfd.	..	37
National Carbon	..	24½			

*Asked. †Ex Dividend. ‡Election.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended March 20 and since December 20 shows:

	1903.	1902.	1901.	1900.
Gross output	84,280	96,557	76,751	65,878
Returned	38,172	42,847	37,517	20,664
Net output	46,108	53,710	39,234	45,214
Since Dec. 20:				
Gross output	305,961	279,553	216,109	183,003
Returned	116,646	114,498	89,427	63,004
Net output	189,315	165,055	126,682	119,959
Total outstanding	3,339,635	2,691,065	2,079,498	1,700,464

The month of March was another exceptionally good one for the Chicago Telephone Company. The gain in subscribers for the period was approximately 1,500, and it is confidently expected that with favorable weather the April showing will exceed that of its predecessor. The company now has in the neighborhood of 64,500 telephones in service and the management predicts that the total will have reached the 75,000 mark by fall.

KEYSTONE TELEPHONE.—The application of the Keystone Telephone Company of New Jersey to have its stock listed on the Philadelphia Stock Exchange has been favorably acted on by the board of governors. The authorized capitalization of the company is $10,000,000, $5,000,000 of which is 6 per cent. cumulative preferred stock and $5,000,000 common stock, each $50 par. The whole of the $5,000,000 common stock, and $1,935,350, or 39,067 shares of the preferred have been admitted to the list. Such preferred as was subscribed for by the public received a bonus of 25 per cent. in common stock. Not having succeeded in raising sufficient funds by stock subscription, the company had to go to the market for a loan. A bond issue became necessary, and a new company had to be formed under Pennsylvania laws. Hence a charter was obtained for the Keystone Telephone Company, of Philadelphia. City councils passed an ordinance in November last granting the new company the same privilege as the old. The Keystone Company of Philadelphia has: Common stock, par $50, $2,500,000; first mortgage 5 per cent. bonds, $2,500,000. The amount of cash put in the property from all sources would, therefore, appear to be $3,353,350, against which there are outstanding in stock and bonds $9,453,350, without including the $2,500,000 stock of the Keystone Company of Philadelphia, owned by the New Jersey Company. The Keystone's net gain of new telephones in March was 684, in comparison with 1,500 in the record month of June, 1902. The average number installed per month has recently been 500, but with new exchanges opened and new cables laid, a larger force can be put to work and a higher average attained. The company has now on hand unfilled contracts for some 5,000 or 6,000 telephones. The Pennsylvania Railroad Company is having its Philadelphia offices and stations equipped with Keystone instruments and other large contracts are said to be pending. The total number of Keystone telephones now in service in the City of Philadelphia is 8,718 and connections are made with 35,000 or 40,000 outside of Philadelphia in the surrounding States.

MEXICAN LIGHT & POWER.—The Mexican Light & Power Company, of the City of Mexico, is rapidly pushing its new work. Mr. F. S. Pearson, of New York, vice-president and consulting engineer of the company estimates as follows in gold the gross earning power of the first installation:

Gross earnings	$912,000
Operating expenses	202,000
Net earnings	$710,000
Interest on $5,000,000 bonds	250,000
	$460,000
The earnings of the first and second installations, combined	$1,732,000
Operating expenses	287,000
Surplus	$1,445,000
Interest on $8,500,000 bonds at 5%	425,000
Net surplus for stockholders	$1,020,000

INDEPENDENT TELEPHONE DEAL IN THE SOUTHWEST.—A deal was closed at Muscogee, I. T., on March 31, which merges all the telephone interests in the Indian Territory, Oklahoma and Northern Texas, control thereof passing into the hands of the North American Telephone Company. This arrangement gives direct communication between all of the lines in the merger with Galveston, St. Louis and Kansas City. The properties involved in the deal are estimated to be worth $5,000,000, and Kansas City capitalists are heavily interested. The plans of the North American Company contemplate connection with Kansas City lines at Chetopa, Kan., and the control of many systems in Southern Kansas. Lines are also to be built from St. Louis to Joplin.

DIVIDENDS.—The directors of the Chicago Edison Company meet about April 15th to declare the regular quarterly dividend of 2 per cent., which is payable May 1. United Traction, of Albany, N. Y., has declared the usual quarterly dividend of 1¼ per cent. The directors of Henry R. Worthington (Inc.) have declared the regular semi-annual dividend of 3½ per cent. on the preferred stock, payable May 1. The regular quarterly dividend of 1½ per cent. will be paid on the preferred stock of International Steam Pump May 1.

BRITISH ELECTRICAL SECURITIES.—The Traction & Power Securities Co., Ltd., which acts as a securities company for the British Westinghouse Electric Manufacturing Co., as noted recently in this column, is to increase its capital from $2,105,000 to $10,000,000 as recently contracts of great value have necessitated a larger working capital.

DENVER GAS & ELECTRIC REORGANIZATION.—The reorganization plan of the Denver Gas & Electric Company made public makes the following propositions: 1. To return to depositors upon the final adoption of the plan their certificates of stock without cost. 2. To make payment to the holders of consolidated bonds of their eighteen months' back interest in scrip, exchangeable in $1,000 denominations for new general mortgage bonds. 3. To issue prior lien bonds—6 per cent. fifteen-year—to the amount of $1,000,000. 4. To issue present treasury stock to the amount of $500,000. 5. To place a new 5 per cent. general mortgage of $8,000,000 upon the property, of which $2,580,000 will be issued in exchange for the present $2,400,000 consolidated mortgage bonds, with the additional $180,000 for back interest; $3,270,000 reserved in the hands of the trustee, to retire the underlying bonds (inclusive of the $1,000,000 prior lien bonds), and $2,150,000 held in the treasury for future extensions and other uses of the company under proper restrictions.

PHILADELPHIA ELECTRIC.—The Philadelphia Electric Company's annual report for the year ending December 31, presented at the annual meeting, shows as follows:

	1902.	1901.	Changes.
Gross income, all sources	$3,422,411	$3,295,971	Inc. $126,440
Op. ex., taxes and fixed charges..	2,967,968	2,980,791	Dec. 12,824
Surplus	$454,443	$315,180	Inc. $139,263
Prev. surplus	446,677	131,497	Inc. 315,180
Total surplus	$901,119	$446,676	Inc. $454,443
Less dividends	337,552	.....	Inc. 337,552
Sur. Dec. 31	$563,567	$446,676	Inc. $116,891

NORTH AMERICAN STOCK.—Subscriptions to the new stock of the North American Company, for which stockholders were allowed to subscribe at par to the extent of 40 per cent. of their present holdings, slightly exceeded half of the $4,800,000 offered, the remainder going to the underwriting syndicate. According to the official circular the purpose of the new stock issue was "to pay for the stock of the Laclede Gas Light Company of St. Louis and to enable the company to extend and increase its investment and interest in the gas and electric lighting business in St. Louis and elsewhere." The total amount of new stock authorized was $5,000,000, increasing the total capital stock of the company to $17,000,000. The covering committee of the New York Stock Exchange has listed $2,594,500 additional North American Company stock, making the total amount listed to date $14,531,200, and empowered the committee on stock list to add the balance of $2,468,800 "on official notification that it has been issued and paid for, making the total amount to be listed $17,000,000."

COLORADO TELEPHONE COMPANY.—The stockholders of the Colorado Telephone Company, at their recent annual meeting, authorized the issue of $1,000,000 new stock to provide for extensions and additions. This will make the outstanding issue $4,400,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Among the favorable features of the week were the annual Easter buying at retail, which was reported of excellent volume; some improvement in the re-assorting demand with jobbers at interior markets resulting therefrom, and a slight but perceptible improvement in the labor situation. Prices during the month of March showed exceptional strength, despite seasonal changes downward in dairy products, grains and fuel, partly counteracted, however, by advances in live stock and meats. Railway earnings are quite favorable; gross receipts for March indicate an increase of between 10 and 11 per cent., while net returns for February showed a gain of 6 per cent. on an increase in gross receipts of 14 per cent. The best trade reports, relatively speaking, come from the leading Western markets, but all centers report a satisfactory spring trade done at wholesale. Retail business has improved in the Central West, but collections fail to show corresponding growth. Southern trade reports are of a more cheerful character. The high water has subsided in the Mississippi Valley and the railroads have resumed handling freight and passengers in the formerly flooded districts. The iron situation is one of marked strength in finished products, but of unsettlement and even weakness in the cruder forms. Domestic rail manufacturers are full of orders, and it is reported that American and Canadian roads are inquiring for steel rails abroad. Structural orders are in large volume. Among the other metals, copper and tin have weakened again, but lead retains its old firmness. As to copper, the metal was offered very cheaply by second-hands, especially abroad. Transactions were few and far between, and the closing quotations were rather nominal at 14 a 14½c. for Lake, electrolytic in ingots, cakes and wire bars, and 14 a 14¼c. for cathodes and casting stock. The business failures for the week ending April 9, as reported by *Bradstreet's*, numbered 153, against 145 the previous week, and 182 the corresponding week last year.

EQUIPMENT FOR PERUVIAN TRACTION SYSTEMS.—An extensive electric traction system is to be constructed between Lima, Peru, and Miraflores and Chorillos, seaside resorts much frequented by residents in the Peruvian capital. Another road will be built between Callao, the port of Lima and that city. The two roads will make a total length of about 30 miles. Power for both the lines will be derived from the existing power plant in Lima. Each of the systems will employ two rotary converters of 300 kw each. This equipment will be furnished by the General Electric Company. The cars for the Lima-Chorillos line—ten in number—will be built at the Stephenson Car Works, Elizabethport, N. J. They will have a 28-ft. body. The trucks will be built by the Peckham Manufacturing Company, Havemeyer Building, 26 Cortlandt Street. They will be 14B3X type. The motor equipments are to be 50-hp ones of General Electric manufacture.

MEAD CONVEYORS FOR CEMENT PLANT.—John A. Mead & Co., Bowling Green Building, New York, have just been allotted a contract by the International Portland Cement Company, of Ottawa, Canada, for a large hot and cold cement clinker conveying plant. The equipment will handle the clinker from the rotary kilns to the clinker storage and thence to the dry grinder mills. The plant will be electrically operated. Almost a similar contract has been secured through the Osborn Engineering Company, of Cleveland, Ohio, for a clinker conveying plant to be installed in the factory about to be constructed by the Midland Portland Cement Company, at Bedford, Ind. This factory's initial capacity will be 1,600 barrels, but is designed with a view to eventually turning out double that quantity. Everything will be electrically driven. The company will generate its own power.

EQUIPMENT OF CANADIAN CEMENT PLANT.—The International Portland Cement Company, which is composed of interests identical with those of the Southern States Portland Cement Company, Rockmart, Ga.; the Peninsula Portland Cement Company, of Jackson, Mich., and the National Portland Cement Company, of Durham, Ont., is about to erect a large cement-making plant at Ottawa, Canada, operated entirely by electrical power. The initial capacity of the plant will be 1,600 barrels. Energy is to be derived from the Ottawa power plant. Contracts will be let very shortly for rotary converters and several motors.

GENERAL ELECTRIC MOTOR EQUIPMENTS FOR SOUTH AFRICA.—The General Electric Company will furnish the motor equipments for the Delagoa Bay (South Africa) electric traction system, the contract for the construction and equipment of which road was recently secured by the British electrical engineering and contracting firm of Macartney, McElroy & Co., Limited. There will be eight double equipments, two 25-hp, for each car.

ANOTHER LARGE MEXICAN ELECTRIC ROAD.—The Rey del Oro Mining Company, which operates extensive mines in the State of Sonora, Mexico, proposes to construct an electric railway, over 200 miles long, to run from its properties to the Southern Pacific Railroad. Power will be generated by a waterfall located in the immediate vicinity of the east terminus.

MEXICO CITY STREET RAILWAY TO BE EXTENDED.—The Compania de Ferrocarriles del Distrito Federal—the Mexico Electric Tramways, Limited—which operates the extensive electric traction system in the City of Mexico and immediate vicinity, is about to construct a line between Loreto and Buenavista—two suburbs of the Mexican capital.

EQUIPMENT FOR NEW DETROIT EDISON PLANT.—Contracts are now being let for the equipment of the big new Edison plant about to be built at Detroit, Mich. The contract for the boilers, which calls for a 12,400-hp equipment in 24 units, has been allotted to the Stirling Company.

PLANT WANTED.—C. C. Radabaugh and others will build an electric light plant at Campbell, Mo. They are now in the market for a 1,500-light alternator, a 100-hp, high-speed engine, and inside and outside supplies. Mr. Radabaugh can be addressed at Malden, Mo.

MEXICAN ELECTRIC RAILWAY.—An electric railway is to be built between the City of Durango and San Dimas, both located in the State of Durango, Mexico. The road will be about 70 miles long. G. B. Denis, of Mexico City, has secured the concession.

TEPIC WATER POWER PLANTS.—Mexican advices state that the installation of several water power plants in Tepic are being contemplated. Ignacio C. Curiel, a Mexico City engineer, is engaged in drawing up plans, etc., for the plants.

WESTINGHOUSE IN EUROPE was treated not long since in an article by Mr. Frank A. Vanderlip, vice-president of the National City Bank of New York, and formerly Assistant Secretary of the United States Treasury, on the general subject of American development across the Atlantic. Financially, the Westinghouse Companies of Europe represent a share and debenture capital aggregating a total of $38,000,000, of which over $30,000,000 has been issued. Commercially the investment of this capital has proved profitable in itself, and has enabled the erection of six large factories, of which two are in England, two in France, one in Germany and one in Russia. The works at Trafford Park, near Manchester, where 27 acres are under roof, are considered the largest and at the same time the most perfect and up-to-date works of the kind in Europe. The most important of the European companies are: The British Westinghouse Electric & Manufacturing Company, Limited, with a share and debenture capital of £3,250,000 sterling, of which £2,750,000 has been issued. The shares and debentures stand at a considerable premium in the market. Among the important contracts which that company is now carrying out are those with the Metropolitan and Metropolitan District Railways of London, the Mersey Railway of Liverpool, the Clyde Valley Power Company of Glasgow, the Admiralty, the Savoy Hotel, the Manchester Town Council, etc. The Société Anonyme Westinghouse of Paris, has an issued capital of 20,000,000 francs, of which a large portion is placed with the leading financial houses of France. They have just secured an important contract with the Metropolitan Railway of Paris. There is a separate company for Russia, a separate company for Germany, and the Westinghouse Brake Company, all of which are purely manufacturing concerns. The Traction & Power Securities Company, as noted recently in these columns, is a financial company closely associated and co-operating with the different Westinghouse companies. Their capital is £2,000,000, of which at present about £1,000,000 has been issued. For the first period of its operation this company has paid a dividend of 6 per cent., after making ample provision for a reserve fund. Mr. George Westinghouse, who directs the policy of all these companies, is chairman of most of them, and Mr. J. H. Lukach, who represents his interests on the other side, is on the board of all of them.

WESTINGHOUSE, CHURCH, KERR & CO. continue to receive numerous export orders for power apparatus. The new Westinghouse horizontal double-acting gas engine, recently placed upon the market, has already been introduced in Mexico, in the power plant of the Potosina Electric Company, at San Luis, Potosi. This installation will contain five units aggregating 1,225 hp, operating on 120 B.T.U. producer gas. An electrical supply company, Lima, Peru, will install a 330-hp Westinghouse compound engine for generator driving, this being an extension to their present plant; 200-hp engine type generating outfits have also been supplied to Negociacion Minera de Promontorio, Durango, Mexico, and to S. Pearson & Son, Limited, Salina Cruz, Mexico. The latter firm has also purchased a number of standard engine generating outfits. The Mexican National Iron & Steel Company, also located at Durango, will install a 45-hp compound engine for general power work, and a 150-hp Westinghouse compound engine type outfit will be installed by Michaelis Hallenstein & Co., Fookeray, Victoria, Australia, for lighting and power work. The demand for Westinghouse junior engines of all sizes, especially from Chilian territory, continues, and a large number of these engines are continually under exportation. The two 1,000-kw Westinghouse steam turbine generating units for the De Beers mines at Kimberley, South Africa, have recently been shipped. These are the largest steam turbines that have been exported from this country up to the present time.

COEUR D'ALENE POWER PLANT.—The Empire State-Idaho Mining & Developing Company, of Spokane, Wash., has purchased of the Westinghouse Electric & Manufacturing Company three motors for driving concentrating mill machinery and a large air compressor in the Coeur d'Alene. These motors will be supplied with power from the 2,300-volt secondary circuits of the Washington Water Power Company, of Spokane, whose 50,000-volt transmission line is now extending into the Coeur d'Alene in Northern Idaho, a distance of approximately ninety miles. There are two 150-hp, three-phase, 2,300-volts, 580-r.p.m. induction motors to be supplied, one for driving the air compressor of the Empire State mine at Wardner, Idaho, the other to operate the Sweeney concentrating mill, a short distance from Wardner. The third motor will be of the synchronous type, 240-hp, 2,300-volts, three-phase, 514-r.p.m., and will drive the concentrating mill of the Tiger-Poorman mines at Burke, Idaho. These motors will be placed in operation about June 1, 1903.

EXPORT TRADE IN FEBRUARY.—We have already noted the excellent export trade figures for February. The detailed electrical figures are not bad in view of the congestion of traffic on the railroads and the difficulty in getting goods to the seaboard from interior manufacturing points. The total export of electrical machinery for the eight months ending February was $4,084,471, against $3,556,070 in the corresponding period of 1902. The output for the month was $416,039, against $592,374 in 1902. The export of electrical instruments for the eight months was $2,742,472, against $2,503,602 in 1901-2. The output for the month was $246,104, against $255,163 in February, 1902. With the freight embargo lifted, vast quantities of electrical apparatus have been going abroad in March and April, both of which should make, therefore, a good showing.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the Exide battery, has added a number of new battery depots to the list of stations hitherto announced, the complete list at present embracing the following stations: New York, 148 West Eighteenth Street; Philadelphia, 250 North Broad Street; Boston, 39 Stanhope Street; Buffalo, 200 Pearl Street; Chicago, 264 Michigan Boulevard; St. Louis, 3937 Olive Street; Rochester, 158 South Avenue; Toledo, 715 Jefferson Street; Detroit, 265 Jefferson Avenue. The increasing use and the great convenience of these depots to users of electrical vehicles equipped with the Exide battery has encouraged the company to increase them as rapidly as favorable locations can be secured. New stations will, therefore, be announced from time to time.

EQUIPMENT FOR JAPANESE ROAD.—Takata & Co., of Japan (10 Wall Street), have secured a contract for the equipment to be used in the installation of a short narrow-gauge electric traction system on a small island in the southern part of Japan. The contract calls for four Westinghouse single equipments and a similar number of narrow-gauge Brill trucks, together with a small quantity of overhead material to be supplied by the H. W. Johns-Manville Company. A lot of Crown bonds of American Steel & Wire Company's manufacture have also been ordered.

NEW BALL ENGINE SHOPS.—The new works of the Ball Engine Company, Erie, Pa., are rapidly approaching completion, and the machine tools will soon be placed in position. These works will be modern in every respect; the tools will be of the latest and best types and will be electrically-driven. The demand for the Ball self-oiling engines still continues very large and the present works of the company are crowded with many months' work ahead, so that it is probable both works will be kept going, for some time to come at least.

THE BARNUM & BAILEY "Greatest Show on Earth" has recently arranged for seventy Nernst lamps, ranging in size from the one-glower to the six-glower type, for the purpose of illuminating their large canvas pavilions, enabling everyone to see the smallest objects at a great distance in the vast arena. To furnish current for operating the Nernst lamps, Barnum & Bailey have purchased special engines to generate power. They will also use the Nernst lamp exclusively for display advertising.

WESTINGHOUSE TURBINE ORDER.—Westinghouse, Church, Kerr & Co. have secured an order from the Rome Brass & Copper Company, Rome, N. Y., for a 400-kw Westinghouse steam turbine unit for both light and power work. A 130-hp Westinghouse vertical cross-compound engine, direct-connected to an alternating-current generator, has also been requisitioned for, which will be operated when the power required to be generated for use in the shops can be supplied by the smaller unit.

THE STANLEY ELECTRIC MANUFACTURING COMPANY has sold the following apparatus to the New York Edison Company, supplementing the half million dollar contract reported in this column some months ago: 1,000-kw S. K. C. generators and seven 150-kw booster sets. The Stanley Electric Manufacturing Company has also contracted to furnish three 550-kw S. K. C. synchronous motors to the Municipal Gas Company of Albany.

BALL ENGINE ORDERS.—The Monongahela Valley Electric Company, Bellevernon, Pa., is adding a 300-hp unit, the Ball Engine Company, Erie, Pa., furnishing the engine. The Morreau Gas Fixture Company, Cleveland, Ohio, has purchased a direct-connected unit, consisting of a 175-hp engine, built by the Ball Engine Company, direct-connected to a 100-kw Westinghouse generator.

BULLOCK ELECTRIC MANUFACTURING COMPANY has recently sold three 1,800-kw generator sets to the Pacific Electric Railway Company, of Los Angeles, Cal.; also a 300-hp, 12,000-volt motor-generator set for San Bernardino, Cal., duplicating the equipment installed a year ago. The Bullock bid was higher than others.

BOILERS FOR HARTFORD (CONN.) PLANT.—The Hartford Electric Light Company, Hartford, Conn., has placed a contract with Thayer & Co., Incorporated, 39-41 Cortlandt Street, New York, for four boilers of 250-hp capacity each, built by the Aultman & Taylor Machinery Company.

BIG LAMP ORDER FOR EXPORT.—The Federal Electric Company, 141 Broadway, has just secured a foreign contract for 100,000 incandescent 16-cp lamps.

General News.

THE TELEPHONE.

CALGARY, ALBERTA.—The Bell Telephone Company will build long distance lines to Cardston and Edmundton.

LITTLE ROCK, ARK.—The Harris & Proctor Telephone Company, of Junction City, has been incorporated with a capital stock of $2,000, to build long distance telephone lines in Union County. The officers are D. F. Harris, president; C. A. Harris, vice-president; J. D. Proctor, secretary and treasurer.

REDONDO, CAL.—Application for a franchise has been made to the Board of Trustees by the Home Telephone Company.

WILMINGTON, DEL.—The American Telephone Company, of Wilmington, has been incorporated to construct telegraph and telephone lines in Atlanta, Ga. The capital stock is $400,000.

MOSCOW, IDAHO.—The Interstate Telephone Company has applied to the city council for a franchise.

MERIDIAN, IDAHO.—The Independent Telephone Company, of Boise, will install a new Globe automatic switchboard at this place.

KINMUNDY, ILL.—The Kinmundy Mutual Telephone Company has been organized.

PEKIN, ILL.—The Citizens Telephone Company will extend its lines from Pekin to Washington.

PONTIAC, ILL.—The Pontiac City Council has granted a 25-year telephone franchise to the Streator Independent Telephone Company.

CHICAGO, ILL.—The Chicago Great Western Railroad will commence next month the construction of a private telephone system between its three terminal points; Chicago, St. Paul and Kansas City.

MOUNT VERNON, ILL.—The Tri-County Telephone Company has elected officers as follows: President, Dr. J. T. Marlow; vice-president, C. H. Judd; treasurer, J. J. Pearce; secretary, W. D. Eaton.

ARMINGTON, ILL.—The Armington Mutual Telephone Company has elected officers as follows: C. Darnel, president; Frank Bogar, treasurer; C. B. Hanger, clerk; J. E. Kelly, George Cruse and A. F. Hoerr, directors.

EDWARDSVILLE, ILL.—Another farmers' telephone line is being constructed in Liberty Prairie, running north from this city, by the Central Union Company. A number of prominent farmers are subscribers and many more will join after the line is in operation.

CHICAGO, ILL.—The Chicago Telephone Company continues to gain in point of new subscribers. During March nearly 1,500 new customers were added to the company's list. The new telephones installed are nearly all party line service, or nickel-in-the-slot kind. The company now has in service slightly more than 64,500 telephones all told, and officials predict that the 75,000 mark will be reached before the summer is over.

STOUT'S CREEK, IND.—The Stout's Creek Telephone Company has been incorporated with a capital stock of $700.

GREENTOWN, IND.—The Sims Co-operative Telephone Company has been formed by the farmers in the east end of the county.

JASPER, IND.—The Crystal Telephone Company has incorporated with a capital stock of $10,000. William A. Line, Walker Mickler, J. M. Sinclair, B. P. Smith and S. N. Clapp are the directors.

INDIANAPOLIS, IND.—The Shady Grove Telephone Company has been incorporated with a capital stock of $100,000. The directors are J. M. Birch, Joseph F. Shelby, W. H. Foster, W. W. Piles and William Tague.

OGDEN, IA.—The Ogden Telephone Company is being incorporated here.

RADCLIFFE, IA.—A franchise has been granted to the Radcliffe Telephone Company.

SIOUX RAPIDS, IA.—A franchise has been voted to a local company for a telephone exchange.

ALEXANDER, IA.—The Latimer Telephone Company has been granted a franchise in this place.

SPENCER, IA.—The Citizens' Telephone Company has been granted a franchise at this place.

COUNCIL BLUFFS, IA.—The Pottawattamie Mutual Telephone Company is seeking a franchise in this city.

MINDEN, IA.—The Shelby Independent Telephone Company has been voted a local franchise in this place.

GOLDFIELD, IA.—The Goldfield Telephone Company has been granted a franchise and will establish a system.

ARMSTRONG, IA.—The Kossuth County Telephone Company will build from 150 to 200 miles of toll line during the summer.

NEW SHARON, IA.—The New Sharon Independent Telephone Company has been incorporated with a capital stock of $25,000.

QUIMBY, IA.—The Farmers' Telephone Company, of Quimby, has been incorporated with a capital stock of $10,000. Mr. M. F. Hoffman is president.

HORNICK, IA.—The Iowa Clark Automatic Switch Company, of Sioux City, and the Peiro Telephone Company have been granted franchises in this place for local exchanges.

WATERLOO, IA.—The Commonwealth Telephone Company has given the Automatic Electric Company a contract for an automatic switchboard which will be installed as soon as possible.

MUSCATINE, IA.—The South Prairie Mutual Telephone Company has filed articles of incorporation with a capital stock of $10,000. The first directors are J. P. Mountain, J. P. Nichols, A. B. Anderson, W. J. Barclay and Adolph Vogel.

LEWIS, IA.—At the recent city election franchises were granted to the Lewis Electric Company, of which Stevens Bros. are the promotors, and to the Town Mutual Telephone Association. The telephone company has already partly established its system.

ONAWA, IA.—The Maple Valley Telephone & Telegraph Company has filed articles of incorporation, with an authorized capital stock of $100,000, of which $50,000 is preferred stock. The officers are president, W. H. Leathers; vice-president, J. C. Hammond; secretary, C. H. Smith; treasurer, T. B. Lutz.

SHENANDOAH, IA.—The stockholders of the Independent Mutual Telephone Company have voted to increase the capital stock of the company to $100,000. The company has made exchange arrangements with the Tabor Telephone Company, thus giving connections with any part of Fremont County from Shenandoah. Toll connections with Red Oak will enable the local company to reach the principal points throughout the state.

TOPEKA, KAN.—The independent telephone companies of Manhattan, Abilene, Beloit, Minneapolis and Concordia have been merged into one concern, which will be known as the Union Telephone and Telegraph Company, with headquarters at Abilene. The capital stock of the company will be $150,000. The stockholders are W. W. Dilworth, A. T. Rogers and F. M. Daily, of Beloit; G. A. Rogers and C. L. Brown, of Abilene; J. W. Smith and F. L. Flint, of Minneapolis; C. P. Dewey and H. P. Wareham, Manhattan, and F. W. Dougherty, Concordia. Rogers, Daily and Dilworth own the Beloit plant; Dougherty owns the Concordia plant; Dewey and Wareham own the Manhattan plant; Smith and Flint own the Minneapolis plant; Rogers and Brown own the Abilene plant. The capital stock of the merger company is divided equally among the five independent concerns. Each gets 300 shares.

LONDON, KY.—The London Telephone Company has been sold by N. Starkey to J. W. Creech, of East Bernstadt, and others. Mr. Starkey has purchased the exchange at Pineville.

LAKE CHARLES, LA.—The Cumberland Telephone Company is making extensive improvements in its service at this place at a cost of about $40,000 to $50,000. The company has 600 subscribers here and orders for 200 more are on file.

PORTLAND, ME.—The Lewiston & Auburn Telephone Company has been organized here with a capital stock of $25,000. The principal share holders are directors in the Northeastern Telephone Company which is now installing an automatic exchange in Portland. The directors of the new company are Thomas R. Brooks and Edward W. Gearhart, of Scranton, Pa., Lewis A. Goudy, of Portland, Edward W. Gross, of Auburn, and Charles C. Benson, of Lewiston.

GALESBURG, MICH.—The village has granted a 30-year franchise to the Citizens Telephone Company.

MUSKEGON, MICH.—The Bell Telephone Company will expend about $7,000 in overhauling the system in this city.

ANN ARBOR, MICH.—Pennsylvania capitalists are endeavoring to secure a franchise for an independent exchange at Ann Arbor.

SPRINGPORT, MICH.—The directors of the Springport Mutual Telephone Company have elected officers as follows: President, Emery Craver; secretary, Jay Courtright; treasurer, W. Elmer; manager, G. Tabor.

DETROIT, MICH.—Mr. William A. Jackson, formerly general manager of the Michigan Bell Telephone Company, the predecessor of the Michigan Telephone Company, has been employed by the Union Trust Company, which is the receiver for the Michigan Telephone Company, to make a thorough examination of all the telephone properties in Detroit to determine their exact value. The Union Trust Company has withdrawn its application for leave to lease the Detroit Telephone Company's property. Don M. Dickinson, attorney for the receiver, stated that the application was made in order to insure service to some 2,600 subscribers during the litigation between the Michigan Company and the Old Colony Trust Company, of Boston. These 2,600 subscribers were formerly subscribers to the Detroit Company and, it is stated, the two systems have been so interwoven it would be impossible to identify the lines, hence the withdrawal of the application.

JUDSON, MINN.—A farmers' telephone company is being organized here.

MADELIA, MINN.—A local telephone company has been organized in this place.

NEW LONDON, MINN.—The Co-operative Rural Telephone Company will build lines in this section. Mr. E. E. Lawson is secretary.

OSAGE, MINN.—The Farmers' Co-operative Telephone Company has been organized to build a line to Park Rapids and other points. Mr. Edward R. Smith is secretary.

ST. PAUL, MINN.—The Eden Valley Telephone Exchange Company has been incorporated with a capital stock of $10,000. The names of the incorporators are C. T. McDonald, M. E. Williams, W. L. Hutcheson, Math. Weiler, William O'Brien, George Tompers and L. R. Christ.

JEFFERSON CITY, MO.—The Buffum Telephone Company, of Louisiana, Mo., with a capital stock of $150,000, has been incorporated by Frank W. Buffum, Charles G. Buffum, Richard H. Goodman and others.

KEARNEY, NEB.—The Buffalo County Telephone Company has been incorporated with a capital stock of $5,000. The incorporators are G. Biscel, Peter Wink, J. G. Reiter and J. D. Lowenhiem.

CRAB ORCHARD, NEB.—The Crab Orchard Home Telephone Company is being formed at this place with a capital of $10,000. Three or four lines will be operated in southwest Johnson County in addition to an exchange in town.

BEATRICE, NEB.—The Filley Independent Telephone Company has filed articles of incorporation. The company is capitalized at $2,000, and is composed of the leading business men of the town. The officers are P. M. Andersen, president; L. C. Andersen, vice-president; R. Petersen, treasurer; Harry Yohe, secretary.

SOUTH OMAHA, NEB.—As soon as the deal can be closed the Interstate Independent Telephone Company of this city will begin the construction of a local system to cost $100,000. It is stated that the Kansas City Independent Telephone Company is the backer of the local enterprise. All of the lines in the business section of the city will be laid in conduits.

EAST CHATHAM, N. Y.—The New Britain Co-operative Telephone Company has been incorporated with a capital stock of $1,000, by Samuel F. Phillips, Dow V. Wadsworth and Chas. H. Carpenter.

ALBANY, N. Y.—The Queechy & Flat Brook Telephone Company, of Canaan Four Corners, N. Y., has been incorporated with a capital stock of $500. The incorporators are O. F. Walker, Ezek Finch and W. J. Lord.

EAST CHATHAM, N. Y.—The Old Turnpike Co-operative Telephone Company, of East Chatham, has been incorporated with a capital stock of $300. The incorporators are O. F. Walker, Esek Finch and W. J. Lord.

MARCELLUS, N. Y.—The Marcellus Telephone Company has been formed by the following named stockholders: D. R. Bowen, A. E. Drake, T. F. Walsh, F. W. Knapp, C. E. Yahu, A. V. Smith, F. T. Schoonmaker, J. E. Woodbridge, A. L. Stone, D. D. F. Coon, C. A. Roe and R. M. Cornwell, of Syracuse.

WAHPETON, N. D.—The Great Western Telephone Company will erect a new exchange building in this place.

EAST ROCHESTER, OHIO.—The Eastern Ohio Telephone Company, of Columbiana County, has increased its capital stock from $5,000 to $25,000. Lewis Walker is president.

COPLEY, OHIO.—The Akron People's Telephone Company has asked that a receiver be appointed for the Copley-Sharon Telephone Company which is owned by William Arnold, of Copley.

TORONTO, OHIO.—A new telephone company has been organized to construct a line between Jewett, Germano and East Springfield with many short branches to the farms along the way. G. O. Fleming is president.

TOLEDO, OHIO.—The Toledo Home Telephone Company has purchased from Barber & Brailey, of Wauseon, a number of toll lines connecting Toledo with surrounding towns. The consideration is said to have been $50,000.

PLEASANT HILL, OHIO.—The Pleasant Hill Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are A. J. Vernier, L. E. Seines, George H. Probeck, C. M. McLaughlin and D. E. Rothermel.

ATTICA, OHIO.—The Farmers' Mutual Telephone Company has been organized with J. W. Walker, president; Jacob Zellers, secretary; Henry Deuchley, treasurer. The company will operate farmers' lines in Seneca, Huron and Wyandot counties.

RICHWOOD, OHIO.—The Richwood Telephone Company is making extensive improvements. New telephones will be installed and a large amount of cable will be put up. Several new toll lines will be built. The company has increased its capital stock to $20,000.

BELLEVUE, OHIO.—The Local Telephone Company has elected these directors: Frank A. Knapp, W. M. Halliday, D. Calhoun, S. M. Wolf, G. A. Wright, C. R. Callaghan, J. H. Beatty, A. K. McConnell and James Verdin. The board of directors authorized extensive improvements to be made at the exchanges at Wakeman, Attica, Sulphur Springs and New London, and a toll line will be built connecting Berlin Heights and Wakeman. The company is in a prosperous condition. A dividend of 1½ per cent. was declared.

GUTHRIE, OKLA.—The Pioneer Telephone Company, of Guthrie, has filed a charter in Kansas, the capital stock being $500,000. The company contemplates building long distance and local telephone exchanges, telegraph lines and manufacturing and dealing in electrical goods in Kansas, Oklahoma and the Indian Territory. The stockholders of the company are John M. Noble, John N. Coulter, J. C. Shepard, Bird McGuire, E. D. Ninis, E. E. Westervelt and D. McKinstry.

BRUCE, S. D.—Mr. M. E. Hall proposes to establish a rural telephone system.

ORIENT, S. D.—A company is being formed to build a telephone line to Miller.

HETLAND, S. D.—The Hetland Telephone Company contemplates extending its system.

PLANKINTON, S. D.—The Plankinton Telephone Company has been organized with a capital stock of $25,000.

HIGHMORE, S. D.—The Stockmens Telephone Company has been incorporated with a capital stock of $5,000.

MILBANK, S. D.—Local business men propose to organize a telephone exchange. Mr. A. F. Lindquist is secretary.

GREENVILLE, TENN.—The People's Telephone Company has applied to the city council for a franchise.

GAINESBORO, TENN.—The Gainesboro Telephone Company has re-elected the present officers, G. W. Stevens, president. The company has some 25 exchanges and 2,000 miles of toll lines. A number of new exchanges and toll lines will be built. The capital stock is $165,000.

SAN ANGELO, TEX.—Sonora is to have a telephone exchange. J. Y. Rust, of the San Angelo & Sonora telephone line, is interested.

GREENVILLE, TEX.—The Home Telephone Company, of Greenville, has been incorporated with a capital stock of $100,000. The incorporators are R. T. Hicks, L. A. Chamberlain, E. D. D. Glandon and others.

SALT LAKE, UTAH.—The name of the Utah Home Telephone Company has been changed to the Utah Independent Telephone Company. C. S. Hall, an engineer from West Virginia, has charge of the work, and as soon as he selects a location the work of erecting a large fire-proof central office will begin.

RAPIDS, WIS.—The Rapids & Western Telephone Company has bought the Western Telephone Company's lines and will make improvements.

BELLEVILLE, WIS.—The Belleville Telephone Company has been incorporated with a capital stock of $5,000. The names of the incorporators are Stanton E. Miller, Henry Ulerich and Orin Scott.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—A franchise has been granted to T. H. Aldrich and T. H. Aldrich, Jr., Trustees for the Birmingham District Coal, Light & Power Company. The company expects to start work within 30 days on by-product coke ovens, using the gases to generate electrical power.

PRESCOTT, A. T.—A large electric power plant is to be located on Fossil Creek, about 57 miles from Prescott.

SANTA MARIA, CAL.—Reuben Hart is about to petition for a franchise for an electric light plant.

STATESBORO, GA.—The citizens have voted to issue $37,000 bonds for an electric light plant and water works.

NEZ PERCE, IDAHO.—Z. A. Johnson will begin immediately the erection of the power house and dam he has had in contemplation. The sites have been selected and contracts let for the building. He will expend $35,000 in the enterprise.

GRANGERVILLE, IDAHO.—The Buffalo Hump Power Company, Ltd., has filed articles of incorporation with a capital stock of $100,000. The plant will be erected at once. The primary object in forming the company was the desire to substitute electricity for steam in the Cracker Jack mine.

SPRINGFIELD, ILL.—A. L. Ide & Sons have petitioned the Council for a franchise for a hot water heating system and electric light plant.

CHICAGO, ILL.—The Perfection Light & Heating Company, of Chicago, has been incorporated with a capital stock of $50,000. The incorporators are I. E. Butter, E. W. Wray and G. M. Ludlow.

ELKHART, IND.—The City Council has granted the National Mfg. Company a franchise for an electric plant. The company proposes constructing a plant at Bristol on the St. Joseph River. Walter Brown is reported interested.

REINBECK, IA.—W. P. Walsh has secured a franchise to install a complete electric light plant.

RADCLIFFE, IA.—The citizens have voted to grant a franchise to the Radcliffe Heating & Lighting Company.

FORT DODGE, IA.—It is stated that the Light & Power Company will enlarge the electric light plant, extend the street railway system and rebuild its gas plant.

IOWA FALLS, IA.—The Ackley electric light and heating plant, valued at $20,000 has been sold to the Daly Land Company, of St. Paul, Minn., and parties from that city will operate the plant in the future.

HARRODSBURG, KY.—J. H. Cochran, of Louisville, has been employed by City Council to prepare plans for an electric light plant to cost $18,000.

BOWLING GREEN, KY.—Jackson & Omberg, of Dyersburg, Tenn., have been employed to prepare plans, estimates, etc., for an incandescent electric light plant in conjunction with the street lighting system already being operated by the city.

GUTHRIE, KY.—According to reports this town is anxious to secure an electric light plant and offers a bonus of $1,000 cash, lease at site upon which to erect a plant for 20 years without consideration, release the plant from municipal taxes for five yearr and a 20-year franchise free. R. F. Warren is town clerk.

NEW ORLEANS, LA.—The City Council has passed an ordinance authorizing Comptroller Tujague to advertise for bids for the construction of a municipal electric lighting and power plant. This means that the city proposes to light the streets and provide power for the public buildings by electricity generated in its own plant.

ANNAPOLIS, MD.—The Independent Electric Light & Power Company is about to petition the City Council for a franchise. H. Lewensohn, of Baltimore, is the promoter and manager.

BALTIMORE, MD.—John Waters, 23 E. Centre St., has secured the contract to erect an electric power sub-station for the United Electric Light & Power Company at McClellan Alley and Little Sharp St. The building and equipment will cost about $100,000.

MALDEN, MASS.—The Malden Electric Company is to enlarge its plant. The new building is to be erected around the present structure. The improvements will cost about $100,000.

SAULTE STE. MARIE, MICH.—Messrs. Wallace-Jaastad-Drewsen, Temple Court, New York, N. Y., will design a new hydraulic power station for the Edison Sault Electric Company.

WINONA, MINN.—C. J. Grove has petitioned the City Council for a franchise for an electric light plant.

CALEDONIA, MINN.—The citizens have voted to issue $8,000 bonds for the construction of an electric light plant.

NICOLLET, MINN.—It is proposed to construct an electric light plant, to cost $3,000. H. A. Hildebrandt, St. Peter, is the engineer.

MANKATO, MINN.—The Council has rescinded all previous actions as to water works, rejected all bids received on March 23 for a building and returned unopened the bids for the lighting plant. J. R. Thompson is city engineer.

FARIBAULT, MINN.—The Polar Star Electric Company is going to put in a motor circuit and will operate it in about 60 days. It will also establish a day commercial circuit.

FARIBAULT, MINN.—The Faribault Gas & Electric Company has been incorporated, capital $250,000. Incorporators: B. W. Cowperthwaite, John Haug and Ellis F. Preston.

COLUMBUS, MISS.—The stockholders of the Columbus Light & Power Company have decided to construct a new electric plant, to cost about $30,000.

STORRS, MONT.—The Cashier Washoe Copper Company proposes to construct an electric light plant and water works under the supervision of P. M. Gallaher, of Storrs.

TRENTON, N. J.—The Illinois Railways and Light Company; capital, $37,000 has been incorporated here by Louis B. Daly, Joseph M. Mitchell, H. O. Coughlan, Warren N. Akers and B. B. Lewis.

NORTH LAWRENCE, N. Y.—L. L. Dewey has purchased the Townsend water power at North Lawrence, and expects to put in electric lights at that place and Lawrenceville.

ELMIRA, N. Y.—The Chemung Electric Company has been incorporated with a capital stock of $3,000. The incorporators are Frank S. Pitcher, William D. Miller and E. Watson Personius.

BINGHAMTON, N. Y.—Bids will be received on April 20 by A. W. T. Back, Clerk of the Board of Supervisors, for the construction of a county heating and lighting plant on the Court House Square.

NEW YORK, N. Y.—The People's Illuminating Company has been incorporated to supply electricity in Manhattan and the Bronx boroughs; capital, $25,000. Directors: C. C. Freeman and H. C. Eldert, of Brooklyn, and W. L. Worrall, of New York.

GARDEN CITY, L. I., N. Y.—The Corporate Electric Company has been incorporated, with a capital of $300,000, to manufacture electricity for light, heat and power purposes in Garden City and the five boroughs of New York City. Directors: Harold S. Recknagel and Walter L. Worrall, of New York, and C. C. Freeman and Henry C. Eldert, of Brooklyn.

BUFFALO, N. Y.—The Frontier Electric Lighting Company, of Buffalo, was incorporated March 26 to operate in Buffalo and the towns of Tonawanda, Cheektowaga and West Seneca; capital, $800,000. Directors: Alex. C. Humphries and Stephen Peabody, of New York City; Howard L. Clark, of Providence, R. I.; Robt. L. Fryer, of Buffalo, and others.

BARBERTON, OHIO.—The proprietors of Barberton Inn are preparing to install an incandescent plant of 2,000 lights.

ATTICA, OHIO.—The village will probably issue $6,000 worth of bonds to insure the building of a municipal electric lighting plant.

TOLEDO, OHIO.—The Council has declined to grant a franchise to the Central Heating & Lighting Company for a heating and electric lighting system.

DAYTON, OHIO.—The Dayton Heating & Power Company has been organized by Henry Zwick, Newton Thacker and others to build an electric lighting and steam heating plant.

RAVENNA, OHIO.—The Ravenna Gas & Electric Light Company has increased its capital stock from $40,000 to $60,000 and will make improvements. Charles Mertz is president.

SANDUSKY, OHIO.—The Central Heating & Lighting Company has been granted a franchise to install a heating and lighting system in Sandusky. The company will erect a plant at once.

MT. GILEAD, OHIO.—The Mt. Gilead Water, Light, Heat & Power Company has increased its capital stock from $60,000 to $70,000 and will make improvements. Mark Cook is president.

DALLAS, ORE.—The Dallas Electric Light & Power Company has been incorporated, capital $20,000. Incorporators: M. D. Ellis and T. A. Wagner.

AVONDALE, PA.—The Avondale Borough Electric Company has been incorporated, capital $10,000. Directors: Edw. H. Wert, C. Raymond Fritcher and Herbert F. Harris, of Harrisburg.

MT. HOLLY SPRINGS, PA.—The Mt. Holly Springs Light, Heat & Power Company has been incorporated, capital $5,000. Directors: Patricio Russ, Harrisburg; C. Faller, of Carlisle, and others.

WESTGROVE, PA.—The West Grove Borough Electric Company, of West Grove, has been incorporated with a capital of $10,000. The directors are Edw. H. Wert, C. Raymond Fritcher and Herbert F. Harris, of Harrisburg.

WESTERLY, R. I.—The Senate has passed the bill authorizing the town to issue $150,000 bonds for the construction of an electric light plant.

RAPID CITY, S. D.—Frank M. Lockhart and W. H. Chambers have secured a franchise from the City Council to build and equip an electric light plant.

FOUNTAIN GREEN, UTAH.—The Fountain Green Electric Light Company will install an electric light plant at Ephraim, Utah.

COLEMANS FALLS, VA.—Gleaves & Co., of Lynchburg, have secured the contract for the construction of a dam and power-house at Colemans Falls for the Bedford Pulp and Paper Company. The contract is reported to amount to about $100,000.

BRATTLEBORO, VT—The Connecticut River Power Company will build a $50,000 dam across the Connecticut at Brattleboro. It will probably be 20 feet high, and generate from 4,000 to 5,000 horse-power.

MONROE, WASH.—S. A. Buck has petitioned for a franchise for an electric light plant.

SEATTLE, WASH.—It is stated that bids are wanted May 9 for $590,000 municipal lighting plant bonds. John Riplinger is City Comptroller.

LA CROSSE, WIS.—It is stated that the Central Electric Company will increase its capital from $50,000 to $100,000 to meet several improvements which have been planned.

TWEED, ONT.—The town proposes to take over and reconstruct the electric light plant which was burned. Water power is proposed. The probable cost of the work will be about $7,000.

TORONTO, ONT.—Bids will be received April 18 by the Raven Lake Portland Cement Company, Toronto, for constructing an electrical transmission line between Raven Lake and Elliott's Falls.

FT. WILLIAM, ONT.—The Council is reported to have contracted with the Anglo-American Power Company, of Chicago, to develop the water power on the Kaministiquia River. The agreement calls for the development of at least 5,000-hp in two and one-half years.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—Application has been made by Leslie C. Brand for a franchise to build an electric railway from Los Angeles to Glendale, a distance of 10 miles, at a cost of $200,000.

PENSACOLA, FLA.—The Pensacola Terminal & Electric Street Railway has applied to the City Council for permission to extend the present system, and to equip a portion of the steam division within the city limits with electricity.

SPRINGFIELD, ILL.—The Quincy & Western Illinois Railway Company has been incorporated, with a capital stock of $500,000, to construct an electric railway from Quincy to Beardstown, and from Rushville to Havana, and from Quincy to Niota.

VINCENNES, IND.—The council has granted a franchise to the Western Indiana Traction Company which proposes to build a road from Vincennes to Sullivan.

WABASH, IND.—It is reported that the Union Traction Company has purchased the Wabash River Traction Company's line between this city and Logansport. The price is said to be $850,000.

MADISON, IND.—The Madison, Greensburg & Indianapolis Electric Railway Company has incorporated with a capital stock of $50,000. Richard Johnson, Nicholas Horuff, M. D. Wilson, N. V. Craven and David Johnson are the directors.

HARTFORD CITY, IND.—The directors of the Muncie, Hartford City & Ft. Wayne Traction Company have elected S. M. Hextor, of Cleveland, president; A. L. Johnson, Muncie, vice-president; and F. M. Osburn, Cleveland, secretary.

LOGANSPORT, IND.—The Western Electric Railway Company, with principal offices in this city, has filed articles of incorporation. The capital stock is $150,000. Newland T. Depaw, H. B. Smith, William Elliott, E. B. Sellers and George R. Ross, Sr., constitute the board of directors.

LOGANSPORT, IND.—The Frankfort & Logansport Traction Company has been incorporated with a capital of $100,000 by J. E. Hillis, W. H. Coulter and W. P. Sidewell, of Frankfort; Dennis Uhl, G. W. Seybold and M. A. Jordan, of Logansport; C. S. Karoly, of Aurora, Ill., and A. P. Clatton, of Chicago.

SIOUX CITY, IA.—Captain R. A. Talbot, of South Sioux City, has filed with the Board of Commissioners of Dakota County, S. D., an application for a franchise granting him the right to construct an electric railway from South Sioux City through Dakota City, S. D., to Homer, S. D.

WICHITA, KAN.—George W. Baumhoff, of St. Louis, engaged as expert to pass upon the advisability of building an electric railway between Wichita and Arkansas City, has reported favorably on the project to the Wichita Interurban Railway Company, which has been organized to build the road. W. E. Wilcox, of Arkansas City, is interested in the company.

OWENSBORO, KY.—The Owensboro City Railway Company has filed a mortgage for $200,000 with the Louisville Trust Company, of Louisville.

NEWPORT, KY.—The council will advertise for bids for electric railways over several routes in Newport. The South Covington & Cincinnati Street Railway Company is seeking the franchise.

WORCESTER, MASS.—The Hartford & Worcester Street Railway Company has organized as follows: Fred C. Hinds, of Boston, president; Thomas C. Perkins, of Hartford, vice-president; Charles H. Wilson, of Boston, treasurer; Charles L. Wilson, clerk; Herbert E. Shaw, of Wales; Charles S. Tarbell, of Brimfield; John F. Hebard, of Sturbridge; Edward Akers, of Charlton; Fred C. Hinds, Charles H. Wilson and Thomas C. Perkins, directors.

ADRIAN, MICH.—The Toledo & Michigan Electric Railway Company has been incorporated for the purpose of building an electric railway from Adrian through the counties of Lenawee, Hillsdale and branch to Coldwater, a distance of about 56 miles. The capital stock is $450,000, and the directors are William P. Heston, Peter P. Duket and Samuel C. Heston, of Toledo; Charles H. Lards, James W. Helme, Jr., and Robert W. Kirk, of Adrian.

CAMDEN, N. J.—The Philadelphia Interurban Railways Company has been incorporated here with a capital stock of $2,500,000. The incorporators named are Edward Chew, Walter J. Parsons and Ralph Boyer.

CHARLOTTE, N. C.—There is talk of building an interurban trolley line from Mullins to Dillon, S. C., and thence to Bennettsville on to Cheran.

BISMARCK, N. D.—The Legislature has authorized the construction of an electric railway from the depot to the capitol, and appropriated $20,000 for the purpose.

DAYTON, OHIO.—The Union Traction Company has been incorporated with $5,000 nominal capital by W. H. Clapper and others.

KENTON, OHIO.—The contract for building the Kenton & Southern Railway has been awarded to the Great Northern Construction Company.

SPRINGFIELD, OHIO.—The American Railways Company, controlling the Springfield Railway Company, is to expend $85,000 in improving that property.

UPPER SANDUSKY, OHIO.—Dr. D. J. Johnson, of Wharton, is at the head of a project to make this city the center of a network of interurban lines.

COLUMBUS, OHIO.—The Urbana, Mechanicsburg & Columbus Railway Company will erect its power house, car sheds and repair shops on a site near this city.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company has placed a contract with F. E. Gribbon, of Cleveland, for the erection of its new power house.

TOLEDO, OHIO.—Toledo parties have recently ordered 10,000 tons of steel rails from Germany for delivery in this city at an early date. They will be used on railways building in Ohio and Indiana.

WASHINGTON, C. H., OHIO.—The Columbus & Washington Railway Company has been incorporated with $10,000 by Richard Emory, Otto Ehring, Frank Johnson, W. R. Pomerene and George Thomas.

COSHOCTON, OHIO.—It is reported that Tucker, Anthony & Company have secured control of a fine water power near Coshocton and will erect a power house there for the proposed railway from New Philadelphia to Newark.

BOWLING GREEN, OHIO.—Stockholders of the Lake Erie, Bowling Green & Napoleon Railway have voted to increase the capital stock from $300,000 to $1,000,000, and bonds to that amount will be issued. The money will be used to extend the road to Port Clinton.

TOLEDO, OHIO.—The Toledo & Michigan Railway Company has been incorporated under Michigan laws with $450,000 capital stock, by W. P. Heston, S. C. Heston, W. W. Betz and P. P. Ducket, of Toledo, and J. W. Helme, C. H. Lards and R. W. Kirk, of Adrian.

TOLEDO, OHIO.—The People's Rapid Transit Company has been incorporated, with a capital of $400,000, for the purpose of building a line from Toledo to Cincinnati. Adam Burger, George Bloodheart, of Toledo; Thomas N. Franey, of Perrysburg, and Albert Merkley, of Tontogany, are the promoters.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company has been incorporated with $1,000,000 capital stock, by George Koehler, W. D. Breed, G. M. Frick, O. N. Little and F. A. Koehler. This is the company that has succeeded the Citizens Railway, Light & Power Company. There will be no change in the management.

CLEVELAND, OHIO.—After many discouraging vicissitudes the financing of the Lake Shore Electric Railway Company, of Cleveland, has been completed, and by order of Judge Wing, of the United States Court, the receivership was terminated April 1. Mr. Albion E. Lang, who was appointed receiver in January, 1902, was discharged and will take a much needed rest.

KELLY'S ISLAND, OHIO.—The Superior Manufacturing Company, of Minneapolis, which owns large lime stone quarries on the island has applied for a franchise to build an electric railway from the quarries to the docks. The islanders are willing to grant the franchises provided the company will build the road across the island and carry passengers during the summer; also install a lighting plant from which the streets can be lighted. The company does not favor the proposition but is considering it.

MAUCH CHUNK, PA.—Hugh E. Crilly, of Allentown, has been appointed receiver of the Mauch Chunk, Lehighton & Slatington Railway Company.

MASONTOWN, PA.—F. A. Maddas, of Masontown, has applied for a charter to build an electric railway from Masontown to McLane's Landing.

PHŒNIXVILLE, PA.—These directors of the Phœnixville & West Chester Electric Railway Company, soon to be chartered, have been elected: A. D. Warner, of Wilmington; W. P. Sharpless and T. W. Marshall, of West Chester; J. W. Howell, of Philadelphia, and R. K. S. Alleback, I. J. Brower and John S. Dismant, of Phœnixville.

TIVERTON, R. I.—The Tiverton & Seaconnet Beach Railway Company is seeking incorporation. William H. Briggs and Abel B. Simmons are interested.

CUMBERLAND, R. I.—The Valley Falls & Franklin Street Railway Company is seeking incorporation to build an electric railway from Valley Falls to Franklin. It will be capitalized at $300,000. Andrew J. Currier, John F. Clark, William H. Bolster are among the incorporators.

NARRAGANSETT PIER, R. I.—The Sea View Railroad Company has in contemplation improvements calling for the expenditure of $100,000. The changes proposed contemplate the generating of all power for both the railroad and the Narragansett electric lighting plant at the power station at Hamilton. There is to be a new engine room, 60 ft. x 65 ft. in size, and a boiler room 55 ft. x 40 ft. in addition to the present plant at Hamilton. Two new engines, one of 600-hp and the other of 400-hp are to be installed in this new plant. Transformers will be installed to step the voltage up to 10,000, and a new transmission line will be built from Hamilton to the Pier. The present power station at Narragansett Pier will be discontinued. A sub-station is to be built at Sea View Junction.

AUSTIN, TEX.—A. J. Dull, of Harrisburg, Pa., and Thomas Pierce, of Boston, Mass., are considering the proposition of building an electric interurban railway between New Braunfels, Tex., and Seguin, a distance of about fourteen miles.

PARKERSBURG, W. VA.—The Ohio Valley Electric Street Railway Company, recently incorporated, has organized as follows: V. B. Archer, president; J. H. McCoy, of Sistersville, vice-president; R. J. A. Boreman, secretary; C. L. Williams, superintendent and treasurer; G. E. Moffett, of New York, consulting engineer; P. H. Anderson, of Friendly, superintendent of right of way.

KENOSHA, WIS.—The Kenosha Electric Railway is to be extended into Pleasant Prairie as far as Grand View Park.

OCATLAN, MEX.—Dwight Furness, of the City of Mexico, has been granted a concession by the Mexican government to build an electric railway between Ocatlan and the town of Jamay.

CITY OF MEXICO, MEX.—Andrew Mackenzie, president of the San Rafael & Xico Railroad, is interested in a project to build an electric railway between Cordoba and Tierra Blanca, Mexico, a distance of about 70 miles.

QUERETARO, MEX.—An electric interurban railway is being constructed between the city of Queretaro and the town of Tequisquiapam, by the Compania Explotadora del Tequisquiapam. The electrical energy will be generated by water power in the Tequisquiapam River.

TORONTO, ONT.—A scheme is being promoted whereby the revenue derived by the city from the Toronto Electric Street Railway shall be put into a special fund for the purchase of the railway company's plant at the termination of the franchise, which has yet 18 years to run.

MONTREAL, QUE.—Plans are being prepared for an electric railway from Montreal to Three Rivers, a distance of 95 miles. The capital of the company will be $500,000. Jacques Bureau, of Three Rivers; Hector Caron, J. H. Legis, Alp. Clermont, R. Cook and A. Cuthbert, of Berthierville; F. O. Lamarche, J. M. Wilson and L. O. Hétu, of Montreal, and others are interested.

NEW INDUSTRIAL COMPANIES.

THE AMERICAN DISTRICT TELEPHONE COMPANY, capital $100,000, has been incorporated by R. M. Beard, S. W. Slayden and B. A. Judd.

THE KENNETT TOWNSHIP ELECTRIC COMPANY, of Kennett township, Chester Co., Pa., has been incorporated with a capital stock of $10,000.

THE WELSH LAFFTUS URANIUM AND RARE METALS COMPANY, of Buffalo, has been incorporated; capital $100,000. Directors: S. T. Lockwood, M. S. Gibbs and G. J. Banta, Buffalo.

THE YORK ELECTRIC & MACHINE COMPANY, of York, Pa., has been granted a charter at Harrisburg, the capital stock being $10,000. This company is manufacturing apparatus used in the production of incandescent electric lamps.

THE BACHELLE AUTOMOBILE COMPANY, of Chicago, has been incorporated with a capital stock of $100,000, to manufacture automobiles and vehicles. The incorporators are Otto von Bachelle, S. W. McKee and J. F. McBridge.

THE ELECTRIC AND POWER MANUFACTURING COMPANY has been formally organized at Spartansburg, S. C., with W. C. Bennett, president and treasurer. The capital stock is $100,000 and the company has the privilege of increasing the stock to $3,000,000.

THE NEW LEXINGTON HIGH VOLTAGE PORCELAIN COMPANY has been incorporated at New Lexington, Ohio, with $30,000 capital stock, by J. G. McDougal, A. Garlinger, C. A. Donahue, P. W. Newlan and J. G. Courtright. The company will manufacture high-voltage insulators.

THE SOUTHWEST ELECTRICAL COMPANY has been incorporated at San Bernardino, Cal., with a capital stock of $25,000. The directors are C. M. Grow and J. W. Curtis, of San Bernardino; C. E. Gage, of Redlands, and H. S. Roach and G. A. Roach, of Riverside. The company will devote itself exclusively to the manufacture and sale of electrical apparatus.

LEGAL.

CUTTING TEXAS TELEPHONE WIRES.—It is an offense under the Penal Code of Texas to interfere wilfully with the transmission of messages along a telegraph or telephone line. The Civil Code of Appeals of that State holds that to constitute an offense under such provision, there must be a breaking, cutting, etc., of some wire, post, machinery, or other necessary appliances, so as to interfere with the transmisison of messages. An action in which the question arose was one by a constable against a telephone company to recover the reward for the conviction of a person guilty of cutting telephone wires, etc., or unlawfully obstructing the transmission of messages. The court also held that the defendant had the right to plead that the wire cut by the person convicted was a dead one, and did not come within the offer, and that plaintiff had personal knowledge that the reward did not apply to such wires. It was further held that a constable who arrests a person for misdemeanor in the discharge of his duties is not entitled to recover a reward offered for the conviction of any one committing such misdemeanor.

PERSONAL.

MR. CHARLES A. COFFIN, president of the General Electric Company, sailed last week on a short European trip.

MR. F. S. PEARSON, consulting engineer of the Metropolitan Street Railway, has gone on a trip to the other side of the Atlantic.

PROF. CLARENCE CHEYNE GORDON, Ph.D. (Gottingen) has organized a course in applied electricity at the Central University of Kentucky, Danville, Ky.

MR. THAD. AVERY, JR., Graeter Electric Company, Dillon, Mont., requests us to state that he wishes to receive catalogues, etc., on all apparatus relating to electrical and power construction, etc.

DR. J. B. DE LERY, who introduced the Wenstrom patents into this country, is now on a visit to the United States. He may be found at the offices of the Federal Electric Company in the Washington Life Building.

MR. P. A. B. WIDENER, the street railway magnate, has offered the city of Philadelphia his entire art collection worth $3,000,000, providing the city will build an art museum at the Green Street entrance to Fairmont Park.

MR. JOHN I. SABIN, President of the Pacific States Telephone & Telegraph Company, has returned to San Francisco to reside. Mr. Sabin's Company now has about 40,000 telephones in San Francisco and over 161,000 on the Pacific Coast.

MR. W. P. CONOVER, JR.—The stockholders of the Philadelphia Electric Company, at the annual meeting, elected Wm. P. Conover, Jr., a director in the place of John M. Mack, who resigned some time ago. Mr. Conover has been connected with the interests of the concern for some years past.

MR. E. R. AVERY, superintendent of the Pony, Mont., Electric Light Company, has recently secured a patent on improved rail joints for connecting the meeting ends of rails without employing the usual bolts or fish plates, and preventing displacement while allowing nominal expansion and contraction.

MR. C. L. EDGAR, president of the Boston Edison Electric Illuminating Company has purchased a majority control in the Greendale Chemical & Electric Lighting Company, of Needham, unincorporated. The company operates on a small scale and has but $7,434 capital. It has a profit and loss balance of $5,488.

MR. CHARLES BRANDEIS electrical engineer of the Montreal Light, Heat & Power Company, was in New York City calling on numerous friends last week and at the office of this journal. He was much pleased at the interest shown in the remarkable power developments in and around Montreal, including the transmission from Shawinigan Falls.

HALL-HANKS.—The marriage is announced on April 8 of Miss Florence Helene Hanks to Mr. Milton Warner Hall, of West Cheshire, Conn. The bride is the daughter of Mr. Wilbur F. Hanks, formerly of the *Electrical Engineer* business staff and more latterly one of the publishers of the well-known "Central Station Directory," and of automobile journals. etc.

MR. G. P. ROBINSON, formerly of the Central Union Telephone Company, of Chicago, has been appointed traffic manager of the entire system of the Sunset Telephone & Telegraph Company on the Pacific Coast. This is a newly-created office. Mr. Robinson will also have charge of the lines, boards, operators and everything pertaining to the working of the system.

MR. FRANK KLEPETKO, consulting engineer, Maritime Building, is now on his way back from Peru, to which country he went in the interests of Mr. J. B. Haggin and associates, who propose to build an electric plant with a capacity of 5,000 horse-power for the purpose of operating a smelting and other plants in the Cerro de Pasco district. Contracts for equipment, etc., are expected to be given out almost immediately after Mr. Klepetko's arrival in New York.

MME. RADDE, who arrived last week by the French liner *La Lorraine*, from Havre, is here to establish institutions for the cure of blindness and tuberculosis. She asserts that she has had great success with her remedy, in which electricity plays an important part. She applies the remedy "through the bones and pores" instead of internally. Her plan is to build hospitals for patients afflicted with partial blindness and tuberculosis in all its stages, incipient and advanced, and she promises to cure multitudes.

MR. P. W. WILLIAMS, of Detroit, who was Governor Roosevelt's telegraph operator on the campaign tour of the West in 1900, is to accompany the President in the same capacity on the present trip. On the tour of 1900 Williams picked up a cowboy hat in a Wyoming town which he converted into an autograph album, securing first the signature "Theodore Roosevelt," and then the names of other members of the party and distinguished persons met on the trip. The hat also bears the name of every State through which the party passed.

MESSRS. OSCAR & THOMAS BRANIFF, JR., of the house of O. & G. Braniff, Mexico City, which concern represents the interests of the Westinghouse Electric & Mfg. Company, are now on a visit to New York for the purpose of conferring with the Westinghouse people regarding the construction of a large hydraulic plant. Two concessions have been secured from the Mexican authorities for the utilization of water from the Atoyac and Tuxpango rivers, located on the Canton of Cordoba, about half way between Mexico and Vera Cruz. The rivers are about three miles apart and the water and the falls are sufficient to generate 50,000 horse-power.

MR. T. H. ALDRICH.—The city of Birmingham, Ala., has granted to T. H. Aldrich and others a franchise for the erection of a gas, light and power plant in Birmingham, Mr. Aldrich paying $7,500 cash for the franchise. Mr. Aldrich will build a by-product plant, using the patents of the United States Gas & Improvement Company, building 150 ovens and using their product. The plant is to be located either at East Birmingham or North Birmingham and will cost $300,000. Mr. Aldrich has come north to complete the organization of the company, which is known as the Birmingham District Light, Power & Gas Company and to purchase machinery for the plant.

MR. CHARLES G. CURTIS, whose steam turbine is now attracting the attention of the whole engineering world is a son of the late distinguished publicist, George Ticknor Curtis. As a graduate of Columbia College, New York, he took up electricity very early in the eighties with his friends, now Prof. F. B. Crocker and Dr. S. S. Wheeler, and the famous "C. & C." motors were one of the first outcomes of his work. Later on he designed and introduced some excellent street railway motors. For several years past his energies have been concentrated on the problems to be overcome in perfecting the steam turbine. He will now give attention to its use on steamships of all sizes.

MR. S. Z. MITCHELL, of Tacoma, Wash., states that the power plant of the Tacoma Industrial Company on White River and that of the Pierce County Imp't Co., on the Puyallup River, will both be operated in multiple for the service of the public on Puget Sound, making the largest and best constructed power plant in the world, outside of Niagara, and will be examples of the very latest and most up-to-date engineering methods. These two water power plants will also work in multiple with the steam plants of the Stone & Webster interests in Seattle and Tacoma, and will have an aggregate normal capacity of practically 50,000-hp. Both plants originated with Mr. Mitchell and are being handled by him.

MR. W. M. ANTHONY, of Chicago, auditor of the Chicago Edison Co., reoprter on office methods and accounting for the twenty-sixth convention of the National Electric Light Association, to be held in Chicago, May 26, 27, 28, has sent out a letter to members, asking for forms, etc., used by them in connection with meters, billing, ledgers, purchases, vouchers, classification of accounts, expenditures and general information as to any matters relating to this department of their business. From responses received, a very complete report is being compiled. The association has already done excellent work in helping central stations to systematize their accounts, the standard classification presented two years ago by a committee of which Mr. Anthony was a member having been widely adopted. His present work will cover a somewhat broader field and is sure to be welcomed by central station managers and accountants.

MR. R. H. PEIRCE, of the company of Peirce, Richardson & Neiler, Chicago, expects to leave Chicago on May 1 to take up his residence in Boston, where an office of the company will be maintained by him. An increasing clientage in the East and some personal interests of Mr. Peirce's in Boston induced the move. Mr. S. G. Neiler will remain in charge of the Chicago office. As has been the case for some time, Mr. R. E. Richardson has given practically all of his attention to the management of the Kansas City Electric Light Company, where a splendid showing has been made in the three years of his management. Messrs. Peirce and Neiler will therefore continue the company's extensive consulting engineering business; the former in Boston, the latter in Chicago. Mr. Peirce in going has the satisfaction of leaving the Chicago branch of the A. I. E. E. in thriving condition, for which he is largely responsible, because of the long years of adversity through which he maintained the office of local honorary secretary and kept the spark of interest alive which has now been fanned into a fire of enthusiasm among the Chicago members of the Institute.

MR. CHARLES A. LIEB, the well-known electrical engineer and inventor of New York City, has invented and patented a guard for automobiles, which when struck in collision or by an outsider automatically shuts off the power, be it electricity, gasolene or steam, and puts on a band brake on the rear wheels. Mr. Lieb has been engaged in motor vehicle manufacture for several years, and has taken out several patents in connection therewith. It was Mr. Lieb's father, George Lieb, who was one of the builders of an automobile trotter, made in the form of a human pedestrian, to comply with the then existing laws prohibiting any but machine driven wagons of human form to be run in the streets of this city. Mr. Lieb's device consists of a guard or fender of bicycle tubing projecting in front of the automobile from a point on a line with the floor of the body, having its sides curving downward. The guard is kept up by a spring. When struck in collision or knocked down by a policeman's club or another's weapon, a crank arm is reversed. Rods connect into this crank arm with the motor and also with a band brake on the rear axle. The reversal of the crank shuts off power from the former and applies the latter.

MR. GEORGE E. FISHER has just returned to Detroit from New York, having completed arrangements with an Eastern syndicate to finance electric railway, lighting and gas properties, which he will undertake to organize, construct and operate. He will continue his office in the Majestic Building, and has already several large railway and gas propositions under consideration. Mr. Fisher was formerly president of the Chase Construction Company, and has had many years practical experience in building and equipping railroads and lighting plants. The construction company has built four of the seven interurban roads running out of Dayton, Ohio, and two of the Cleveland roads, as well as several electric railroads in Indiana and Pennsylvania, all of which are in successful operation. Mr. Fisher also secured the contract for the entire municipal lighting plant for the City of Grand Rapids. He is president of the Pontiac Standard Lighting Company, being a two-thirds owner of this plant, which has been lighting the City of Pontiac for a period of twelve years. During this time, the construction company has built and equipped some sixty central station lighting plants through Michigan, Ohio and Indiana. It is understood that Mr. Fisher's relations with the syndicate being formed by Jas. T. Lynn, who recently moved to New York, are very close, and it is probably through its office that the gas properties will be handled. This syndicate now controls gas and lighting plants in twenty-six cities.

OBITUARY.

MR. HENRY VAN BRUNT, a well-known architect, who designed the Electricity Building at the Chicago World's Fair of 1893, is dead. He was a native of Boston and a resident in Kansas City.

MR. W. W. CARD, second vice-president of the Westinghouse Air Brake Company was run down by a trolley car in Wilkinsburg, Pa., near his own home, on April 4, and was killed. He entered the service of the company in 1872 and became its secretary in 1879. He was connected with other important enterprises, and was a man of considerable wealth, which he used freely for public objects.

MR. JAMES W. BENNETT, Mayor of Lowell, Mass., in 1897, died in that city on April 14, after a lingering illness. He was a native of Newmarket, N. H., where he was born in 1833. He was for many years interested in the Erie Telephone Company, and served as its president. He was a director in the Wamesit National Bank. He served as a member and chairman of the Republican City Committee of Lowell, was a member of the City Council, Water Board, and then served two years in the lower branch of the Massachusetts Legislature.

MR. S. MORGAN SMITH.—We regret to note the death of Mr. S. Morgan Smith, of York, Pa., president of the S. Morgan Smith Company, at Los Angeles, Cal., aged sixty-five years. Mr. Smith was one of the largest manufacturers of water wheels in the United States. He went to Los Angeles two months ago for the benefit of his health. The industry which he developed was one of the best known in its field in this country and abroad, and large numbers of the wheels he built are to be found in modern hydroelectric plants for power generation and transmission.

EDUCATIONAL.

UNIVERSITY OF MISSOURI.—The class in geology and mining of the Missouri School of Mines and Metallurgy will make a summer excursion this year, in charge of Director Ladd, to the Black Hills, Butte and Anaconda and the Yellowstone Park. Similar excursions will in the future be a required part of the work of this institution. The new catalogue of this School announces that there will be made, during the spring and summer months, as a part of regular courses, excursions to the Joplin mining district for mine surveying; to the Gasconade River for field practice in lines of communication; to southeast Missouri for geological field work; and to Joplin, St. Louis, Herculaneum and the Flat River district for the study of mines and ore-dressing and metallurgical plants.

Trade Notes.

AMERICAN MICA COMPANY has moved its general offices to the factory at Newton Lower Falls, Mass.

EXHAUST HEADS.—The Baldwin Locomotive Works has sent to the Burt Mfg. Co., Akron, Ohio, its 16th order for exhaust heads, to be used in the works.

THE NATIONAL ELECTRICAL SUPPLY COMPANY, Washington, D. C., has issued a couple of bulletins illustrating and describing one style of its party-line telephone switchboard and the improved bulls-eye combination drop and jack.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has published a new telephone price list dated April, 1903. This price list contains a complete line of telephones and telephone parts, also construction material of every description. A copy will be sent upon application.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., in bulletins 33 and 34, describe and illustrate electrical apparatus for motive power in machine shops and the use of electric power in the making of cement. The latter subject was covered in our issue of July 19, 1902, when the cement-making plant at Alsen, N. Y., was fully described and illustrated.

ELECTRO-THERAPEUTICAL APPARATUS.—The Des Moines Battery & Electric Company, Des Moines, Ia., has issued a pamphlet descriptive and illustrative of its electro-therapeutic apparatus and devices. It gives copies of a few indorsements received by it showing that its combination battery is giving the best of satisfaction to all users of the same.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agent for Gutmann alternating current wattmeters, is especially enthusiastic just now over the large sales of its glass-case meter. It is neat in appearance, light in weight and small, and its superior workmanship guarantees maintenance of accuracy and of service. It will send its new wattmeter catalogue to any one interested.

THE WHEELER REFLECTOR CO., 156 Pearl St., Boston, reports business as increasing in the various lines of reflectors which it manufactures. It was compelled by steadily growing demands to remove from its old location at 100 Purchase St. In the new quarters it has every facility for taking care of all orders. The business this year shows an increase of 50 per cent. over that of last year.

THE PRESIDENT'S TELEPHONE.—A letter has been received at the office of the Stromberg-Carlson Telephone Manufacturing Company in acknowledgment of receipt of a gold paper weight, which was a reduced model of the Stromberg-Carlson receiver, mounted on a base. A small silver plate bearing the words "To the President" fastened to the base completed an attractive ornament, which was presented to the President April 2nd, as a souvenir of his visit to Chicago.

UNITED TELPHERAGE COMPANY, of 20 Broad Street, New York City, has issued a very interesting bulletin in Circular No. 22, showing and describing the equipment of a dock freight shed with the electric telpher system. A speed of 1,000 to 1,500 feet per minute can be made, and the telpher can be raised clear of the floor in travel. The truck for freight is ten feet long. One telpher and three trucks will elevate, convey, lower and return faster than ten men can load and unload with drays.

PRIZES FOR MECHANICS.—Men who use or employ chain blocks will be interested in the offer of the Yale & Towne Mfg. Co., of prizes for information from mechanics concerning triplex chain blocks. This contest is open to all. Practical statements are the only thing required, and not fine writing. There is no question that scientific chain blocks are as much a benefit to the man behind the chain as to the one behind the bills; and any enlightenment on this subject is bound to be eventually profitable to both. Employers ought to call the attention of their foremen and mechanics to this offer.

STILWELL-BIERCE-SMITH-VAILE CO. has recently opened an office at San Francisco at 11 and 13 First Street. The pumping machinery and air compressor departments will be looked after by Mr. Geo. W. Ingils, formerly with the Worthington and other pump interests. The water wheel department will be in the care of Mr. Edward G. De Wald, one of the company's assistant engineers, who has hitherto traveled from the Dayton headquarters and had made several successful trips to California in regard to large turbine equipments for high heads.

HUNTER ADVERTISING SIGN.—The Hunter Electric Advertising Sign Company, of Cincinnati, recently incorporated, has a capital stock of $20,000, all of which has been subscribed. The concern is as yet manufacturing only in a small way. Its plant will be located at 118 East Front Street, and its offices 304 Commercial Tribune Building. The company has control of a new device for the display of advertising on a movable curtain or screen, with various electric lights behind it. George B. Roley is president; Samuel Cohn, vice-president; J. C. McWilliams, treasurer, and John F. Ankenbauer, secretary.

THE ST. JOSEPH BOAT MANUFACTURING COMPANY, of St. Joseph, Mich., announces that it has developed an unusually attractive line of electric and vapor launches, combining to a very high degree of perfection the desirable features of speed, comfort and economy in operation. The company has under construction a large twin screw excursion steamer, embodying a very unique design for shallow draft, to ply the St. Joseph River. This company builds all kinds of ocean, lake and river going craft. Mr. Ernest F. Smith, vice-president and general manager of the company, announces contracts for craft to the limit of the company's productive capacity for some months ahead.

MACHINE AND FAN SPEED CONTROLLERS.—A bulletin has been issued by the Ward-Leonard Electric Company, of Bronxville, N. Y., covering its latest "open" types of machine and fan speed controllers. The resistance part of these controllers is stated to be non-corrosive, moisture proof and non-abrasive, as well as possessing the feature that the turns of the coils cannot become short circuited. There is therefore no fire risk. Considering the special automatic features, shown in this bulletin, in connection with the properties of the resistance itself, it would seem that every essential requirement for machine or fan speed control is embodied in these types of controllers.

A REMARKABLE TRAFFIC RECORD.—On Tuesday, February 3rd, the New York Central handled a total of 25,982 cars. This exceeded by 500 the maximum number of cars ever moved in one day. This record, however, was again broken on Tuesday, February 10th. For the twenty-four hours ending 11.59 P. M. on this date the New York Central moved 16,605 loaded cars and 9,480 empties, a total of 26,085, which is the largest number of cars ever handled in one day on this line. On the same date the Lake Shore Railway handled 10,915 loaded cars and 3,316 empties, a total movement of 14,231 cars; or a total on both lines of 40,316 cars. This exceeds all previous records in the handling of cars on these lines.

A RAILROAD NUMBER.—The April issue of *The Booklovers Magazine* is largely a railroad number. An article on "The Men Behind the Railroads," by E. J. Edwards ("Holland") gives an excellent and authoritative account of the course of railroad consolidation from 1896 to the present. His discussion of the personalities behind the movement is illustrated by admirable portraits in tint of A. J. Cassatt, William K. Vanderbilt, George J. Gould and James J. Hill. Mr. Henry Lloyd contributes a lively and pointed article on the discussion of railroad consolidation from a radical point of view, while Mr. H. T. Newcomb, of the *Railway World*,' shows the benefits this movement has brought to the small investor.

SPRAGUE BOWLERS.—Some fifteen or twenty representatives of the different departments in the general office of the Sprague Electric Company, New York City, have inaugurated a bowling club, which met for the first time on Thursday night, April 2nd. A number of the men proved to be first-class bowlers, and a very enjoyable evening was spent by all present. Mr. Tretheway, of the engineering department, was captain of one team and made the highest score, bowling 202 in the second game. Mr. Taylor, of the treasurer's department, was captain of the other side and made the second highest score, 183. After the bowling supper was served, which was followed by vocal and instrumental music by the members.

"HOW TO PACK GAS ENGINE CYLINDER HEADS," is an interesting leaflet, giving full directions for cutting gaskets, preparing the flange and applying the gasket, so that the most efficient service may be obtained. The difficulty of packing cylinder heads of gas engines for stationary, launch or motor service has been one of the discouraging features in the use of these engines. The methods described in the leaflet have been proved by years of experiment to be successful in avoiding the difficulties and securing the best results. Anyone interested can secure a copy of the leaflet from the H. W. Johns-Manville Co., 100 William St., New York, or from its branch offices in Milwaukee, St. Louis, Chicago, Pittsburg, Cleveland, New Orleans, Boston, Philadelphia and London.

SOCKET AND CLUSTER FINISHES.—Harvey Hubbell, Bridgeport, Conn., has just issued a large sample card of the special finishes he is introducing for sockets and clusters. The card shows in full size, half section, nine of the finishes applied to socket shells, and enumerates no fewer than eleven others in which the goods can be obtained. The various shades of brass, gold and silver, of bronze, copper and wrought iron, are most beautifully brought out in these handsome goods, and Mr. Hubbell will inevitably derive a rich reward for his enterprise and taste, while the influence exerted on the art in general must be excellent. We recommend all our readers interested in any way in lighting fixtures to get one of these sample cards. They will then order the goods.

THE NEW YORK & OHIO COMPANY, Warren, O., which recently placed a line of insulating cloths and varnishes on the market is issuing sample books showing about a dozen specimens of various grades of insulating cloth and paper. Among these it calls special attention to its "soft finish" muslin. Instead of using a preliminary coating or filling of starch to lay the nap, as is customary, the nap of this particular cloth is singed or burned off. Since nothing but pure varnish is used, the result is a perfectly flexible cloth, and one which cannot lose its insulating qualities through deterioration. The entire line of cloths and varnishes is the direct result of the company's own experience in seeking the very best materials obtainable for use in Packard high potential transformers. It goes without saying, that the high standard implied in the name Packard will be fully maintained.

MAST ARMS, ETC.—The name of T. H. Brady, of New Britain, Conn., has been associated with the development of outside construction and fixtures for electric light lines almost since the beginning of the art of electric lighting, and the fact that he is still at the old stand and doing more business than ever is proof that his products are of the best and standard quality. In a neat catalogue of 64 pages, just issued, Mr. Brady illustrates his line of electrical specialties, including mast-arms, fuse and cut-out boxes, knife switches, hanger boards, storm protectors, lamp holders, storm-proof pulleys, hoods, brackets, etc. Accompanying each illustration is a brief description of the features of the device so shown, together with the prices of the different styles, sizes, etc. Mr. Brady's business was established in 1879, and has kept pace with the development of electric lighting. By keeping close tab on the requirements of the art, and indeed anticipating its wants, Mr. Brady has succeeded in building up a large trade in his special line. He will be glad to send a copy of his latest catalogue to anyone interested.

W. E. FAN MOTORS. The Western Electric Company's Catalogue of 1903 fan motors, just issued, bears evidence of having quite as much pains and thought bestowed upon its production as are given to the manufacture of its motors. Like the fans, each year's catalogue is an improvement on its predecessors. This year's catalogue cover is a work of art, the design representing relief work, with high lights and deep shadows, on a mottled background. A handsome illustration of a desk fan occupies the centre, and is so realistic that it is comforting to look at. On the inside of the front cover two fine half tone views of the company's Chicago factories are given. The contents of the catalogue are no less artistic. There are shown desk fans, bracket fans, ceiling fans, ventilating fans, etc. These fans are in the direct-current and alternating current types and of many styles and finish. The principal constructional features, current consumption, voltage, and other information are given for the benefit of the trade, and there is a complete code for facilitating ordering by telegraph. On the back cover are given front and rear views of the company's New York factory.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 7, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

724,451. SIGNALING APPARATUS; Francis W. Dunbar and William W. Dean, of Chicago, Ill. App. filed Dec. 26, 1900. (See page 657.)

724,478. SWITCH MECHANISM FOR TELEPHONE-TRANSMITTERS; Charles Holmok, of Cleveland, Ohio. App filed April 30, 1902. (See page 657.)

724,484. FIELD MAGNET CORE; Charles R. Meston and Thomas M. Meston, St. Louis, Mo. App. filed June 14, 1902. A field magnet core composed of laminations in which less metal is presented at the polar face by some of the laminations than by others.

724,498. ELECTRICAL MOTOR FOR CEILING FANS; Walter F. Phelps, Dayton, Ohio. App. filed Feb. 2, 1903. The resistance devices are mounted upon a stationary part of the motor below the moving part thereof.

724,507. ELECTRICAL PROTECTOR; Charles A. Rolfe, Chicago, Ill. App. filed June 6, 1900. (See page 657.)

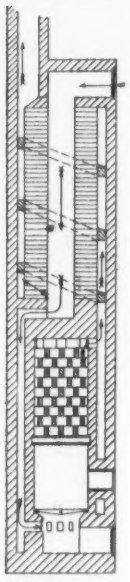
724,544. ELECTRIC BRUSH HOLDER; Niels A. Christensen, Milwaukee, Wis. App. filed May 16, 1900. Relates to the means for adjusting the force with which the brushes are held against the commutator and to other details.

724,572. THERMO ELECTRIC BATTERY; Benjamin J. Hall, Barnes, England. App. filed July 16, 1902. The improvement consists in so arranging the parts in conjunction with a suitable furnace as to form a cold air inlet channel on one side of the furnace and a hot air outlet channel on the other side.

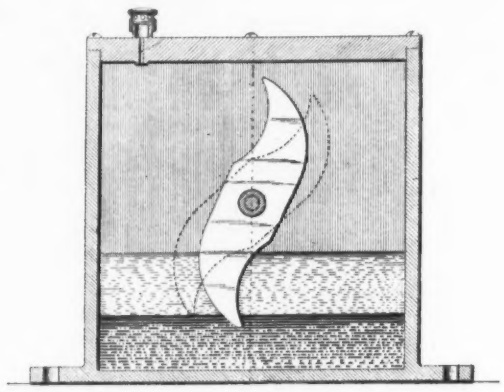
724,580. ELECTROLYTIC CELL; Rudolph Johanns, Brooklyn, N. Y. App. filed Dec. 11, 1902. An inverted trough is arranged above the cathode and a conduit extends from it to a point beyond the limiting surface of the electrolyte, for the purpose of uniformly distributing the incoming brine. (See page 656.)

724,594. TELEPHONE SYSTEM; John H. Mason, Philadelphia, Pa. App. filed April 12, 1902. (See page 657.)

724,611. CONTROLLING DEVICE FOR ELECTRIC MOTORS; William B. Potter, Schenectady, N. Y. App. filed Aug. 13, 1898. A lost-motion connection between the handle of the switch and the circuit changing devices together with means for causing said devices to follow the motion of the handle at a uniform rate irrespective of the speed with which the motorman may operate the latter.



724,572.—Thermo Electric Battery.



724,704.—Circuit Breaker.

724,613. LOW WATER ALARM FOR STEAM BOILERS; Stephen H. Ralph, Marion, Ind. App. filed July 31, 1901. Details.

724,619. ELECTRIC ACCUMULATOR; Albert Schmidt-Predari, Weimar, Germany. App. filed July 24. 1902. A lead plate and a magma for the negative pole electrode, composed of a mixture of lead oxide, red lead, calcium hydroxide, alkali thiosulphate and a suitable binding material.

724,627. SYSTEM FOR THE ELECTRICAL PROPULSION OF CARRIERS; Abram D. Swegle, Fayette, Mo. App. filed July 18, 1902. A switch supported by the carrier and adapted to be automatically controlled to affect a circuit including the motor and a magnetic brake.

724,628. TELEGRAPH KEY; Edwin T. Thorpe, Dickerson Run, Pa. App. filed Dec. 12, 1902. An auxiliary spring-supported button is placed above the key to afford a yielding action.

724,645. MEANS FOR PREVENTING FLUCTUATIONS IN ROTARY MOTORS; James J. Wood, Fort Wayne, Ind. App. filed May 31, 1900. The fly-wheel is connected to the shaft through a spring to compensate for fluctuations.

724,662. CONTROLLING DEVICE FOR ELEVATORS; Albert H. Buckelew, Newark, N. J. App. filed Nov. 17, 1897. A push button system with which anyone can operate the elevator and including certain safety devices.

724,704. CIRCUIT BREAKER; Samuel T. Hutton, Chicago, Ill. App. filed March 15, 1902. A shaft carrying a rotating arm is mounted in the wall of a box containing mercury; the rotation of the shaft brings the arm intermittently into contact with the mercury.

724,705. ORE SEPARATOR; Hans G. Johnson and Monroe S. Howard, Waukon, Iowa. App. filed Sept. 5, 1902. Details.

724,721. ELECTRIC TOOL HOLDER; Max Loewenthal, New York, N. Y. App. filed July 24, 1902. When the tool is applied to the holder, a heating circuit is automatically closed.

724,722. ELECTRICAL CONTROLLING SYSTEM FOR ELEVATORS; Cyprien O. Mailloux, New York, N. Y. App. filed July 23, 1896. A simplification of the invention described in patents 536,730 and 543,495.

724,724. PRESSURE GAGE FOR STEAM BOILERS OR THE LIKE; Frederick Mitchell, Redcastle, Victoria, Australia. App. filed May 22, 1902. An adjustable contact is arranged so as to close a circuit when struck by the index of the gauge.

724,730. CUT OUT SWITCH FOR ELECTRIC LIGHTING OR OTHER CIRCUITS; Geo. W. Nistle, Chicago, Ill. App. filed April 28, 1902. Details of a switch in which contacts are arranged on both sides of the pivot of the lever in such a manner that the circuit on one side is closed before the other is opened.

724,762. THIRD RAIL ELECTRIC RAILWAY SYSTEM; Wm. G. Wagenhals, Cincinnati, Ohio. App. filed Jan. 28, 1903. An arrangement for mounting an inverted third rail.

724,778. ELECTRICAL SMELTING APPARATUS; Robert L. Barnhart, Charleroi, Pa. App. filed May 14, 1902. The minerals are suitably fluxed and made into the form of paste, which is then formed into rods; these are used as electrodes between which an arc is formed to smelt the mineral.

724,827. ELECTRIC MOTOR; Arthur C. Eastwood, Cleveland, Ohio. App. filed Jan. 15, 1903. Instead of starting a motor by means of the usual rheostat, the relative speed of rotation of the field and armature is controlled.

724,842. VOLTMETER FOR THE ELECTROLYSIS OF WATER; Pompeo Garuti and Riccardo Pompili, Tivoli, Italy. App. filed April 11, 1902. An improvement on patent 629,070, relating chiefly to a modified form of the metallic diaphragm used therein. (See page 656.)

724,848. INSULATOR; Ferdinand W. Gregory, New York, N. Y. App. filed Aug. 9, 1902. A knob insulator having a flat side containing a straight groove in which the wire is held.

724,853. SOLDERING IRON; Charles R. Gutner, Brooklyn, N. Y. App. filed Aug. 13, 1902. Details.

724,856. SECONDARY BATTERY ELECTRODE; Josef Hahmann, Berlin, Germany. App. filed July 19, 1902. Details.

724,860. ATTACHMENT FOR OVERHEAD ELECTRIC CARRIERS; Henry M. Harding, New York, N. Y. App. filed April 21, 1902. The conductors are housed in a slotted conduit to prevent sparks from falling therefrom.

724,862. CATHODE; Charles J. Henry, Perth Amboy, N. J. App. filed Aug. 6, 1902. A frame used as a cathode in the production of metallic sheets by electrodeposition, arranged so that the sheets can be readily stripped from the cathode. (See page 656.)

724,917. AUTOMATIC AUDIBLE FIRE ALARM TRANSMITTER AND SIGNAL; John H. Munchausen, Brooklyn, N. Y. App. filed Feb. 25, 1902. Details.

724,927. TROLLEY; Charles A. Olsen, Pittsburg, Pa. App. filed Dec. 24, 1902. The trolley arm has a knuckle joint enabling it to open and close as the elevation of the wire changes.

724,928. ELECTRIC CONTROLLER; Carl T. J. Oppermann, London, England. App. filed Feb. 18, 1903. An arrangement whereby four different speeds forward and one backward are obtained with the fewest number of contact pieces.

724,948. VENTILATOR FOR ELECTRIC MOTORS FOR CARS; Horace B. Rowland, Philadelphia, Pa. App. filed March 25, 1902. This patent and those which follow in the same name relate to the collection of air by a funnel and conducting the same to a casing surrounding the motor for cooling the latter.

724,949. VENTILATING DEVICE FOR ELECTRIC MOTORS FOR CARS; Horace B. Rowland, Philadelphia, Pa. App. filed April 19, 1902. See preceding patent.

724,950. VENTILATOR FOR MOTORS FOR CARS; Horace B. Rowland, Philadelphia, Pa. App. filed May 13, 1902. See 724,948.

724,951. AUTOMATIC ELECTRIC ELEVATOR; Harold Rowntree, Chicago, Ill. App. filed June 28, 1901. The system includes among other things two motors one of slow speed and the other of high speed and means for transferring the load from one to the other.

725,001. INDICATING AND CONTROLLING APPARATUS; Cyprien O. Mailloux, New York, N. Y. App. filed July 23, 1890. (See Current News and Notes.)

725,006. FUSE BLOCK; John B. Morgan, Youngstown, Ohio. App. filed Aug. 7, 1902. Details.

725,010. AUTOMATIC CIRCUIT OPENER OR CLOSER FOR ELECTRIC BELLS, ETC.; Carl C. Rasmussen, Harlan, and Hans P. Rasmussen, Callender, Iowa. App. filed Sept. 26, 1902. A rotary circuit closer is arranged in connection with a belt and driven thereby; centrifugal force keeps its terminals apart until the belt stops, when the terminals collide and send a signal.